Choosing_a_College_Roomate

[MUSIC PLAYING]

-Oh, hi Samantha. How is everything going on? You seem to be drowned in your thoughts. Is everything all right?

-Hi Maddie. Sorry I didn't notice you passing by. You know my roommate Zoey, right?

-Oh, yeah. I've met her before. She seems like such a nice girl.

-Yeah, she's great. It's just that she's graduating this semester, and she's moving back home, so I'm trying to find a new roommate.

-Oh, so how is the search going on?

-Well, so far I've made one of those roommate ads and put it up on the dorm billboard. I've met several candidates, but it's just so hard deciding who's right for me. They're all so different it's like comparing apples and oranges.

-Comparing apples and oranges? But what does that mean?

-You know, it means comparing two things or two people that are so obviously different that they can't practically be compared.

-But who says you cannot compare apples and oranges?

-What do you mean?

-I mean, there are different attributes on which you can compare apples and oranges. So for example, imagine that you want to stop by a grocery store to buy some fruits, and you only have one choice. You can either buy apples or oranges. How would you go about choosing between these two?

-Well, I would definitely look at their prices. I don't want to go beyond a specific price range when doing my grocery shopping. And I guess I would look at nutritional facts when buying fruits. So I guess I could compare apples and oranges based on nutritional attributes like fiber, vitamins, or calories.

-Right. Now that I think about it, there are some attributes that are only important in specific contexts.

-Oh? How so?

-So imagine that you're at an airport instead of a grocery store, and you want to buy something to eat before your flight. Which one would you pick now? Apple or orange?

-I guess I would pick an apple because it's less messy and it's easier to eat without a knife.

-Right. Also you would care about shelf life if you want to put the fruits in storage, but not when you want to eat them right away. So I would say context also matters.

-Huh. That's interesting. So I guess you could compare different things based on the different criteria you have for making your decision. This means I can actually compare these different roommate candidates on the criteria I have in mind.

-Right. There are many different personal decision contexts that involve multiple criteria, like when you want to buy a used car. So I want you to think about the decision contexts that you may face that includes multiple criteria, and discuss it with your classmates and your teacher. Then we'll be back in a few minutes to see if we can help Samantha choose between these roommate candidates.

[MUSIC PLAYING]

-You know Maddie, now that I think about it, there are many decision contexts which include multiple criteria, like which college to attend, which job offer to accept, which cellphone plan to choose, which apartment to rent or laptop to buy.

-That's right. All these decisions involve comparing alternatives that have strengths and weaknesses with regard to multiple criteria that are of interest to the decision maker. So for example, in the case of choosing an apartment to rent, one might want to minimize monthly rent and at the same time maximize the size of the apartment and the safety of the apartment. So sometimes these criteria could get in each other's way.

-Wow, I really like the way you put it.

-Actually, I had a course this semester where I learned about a decision making methodology that's very helpful in making such decisions. I actually used it myself to buy my used car. It's very helpful in structuring the decision and making the final choice.

-That's awesome. What's this method called?

-It's called Multiple Criteria Decision Making, or MCDM.

-So do you think that I could use MCDM to find the best roommate candidate?

-Oh, absolutely. You know what? I can actually walk you through the steps. It's a pretty straightforward method.

-Oh, really? What a relief. Thanks Maddie!

-Sure.

-It's just so difficult choosing between these four girls because there's good aspects and bad aspects between them.

-Right. I mean, when you use MCDM methodology, the final result would be a rank order of these four roommate candidates that would represent your preferences.

-Perfect. How do we get started with this process?

-So the first step is to identify the criteria that's important in making the decision. You know, what you really care about when you want to choose a roommate. And these involve the things that you would like to either maximize or minimize in your final choice. So why don't you tell me the important criteria you have in your mind for choosing a roommate?

-Well, I guess I'm looking for someone that when they're in the room, they won't interfere with my studying. I don't like to use the library, so I like to be able to study quietly in my room.

-So we can say that the first criteria is maximizing effective studying.

-Next, probably like to choose someone who I'm compatible with. I don't like roommate conflicts, and it'd be nice to get along with my roommate.

-That's correct. So the second criterion would be minimizing conflict.

-Oh, and I really want to have fun with the whole experience of living in the dorms. It's a big part of my college life, so I'd like to find a roommate who wants to have fun as well.

-I totally agree. So the third criterion would be maximizing fun. What else?

-I think these cover everything I care about in a roommate.

-Perfect. So we're done with the first level of the MCDM methodology.

-Cool! That was quick.

-Yeah. Now let's ask the students in class. What criteria would be important to you if you wanted to choose a roommate in college? What if the context is a little bit different? What criterion would you maximize and minimize when choosing someone to share an apartment with while working at a job?

[MUSIC PLAYING]

You know Samantha, if I were to choose a roommate in college, my criteria would be slightly different.

-How so?

-So I always study in the undergraduate library. It's close to the dorm and it's open 24/7. So I really don't care about my roommate's study habits. Therefore, I would not have a criteria for maximizing effective studying. But I really think it's important to have someone that you can rely on, someone that you can trust and depend on when you're facing difficulties. So I would say maximizing dependability would be one of my criteria.

-I understand. The whole point of this process is that each person cares about different things when making a decision, and therefore has different criteria.

-Exactly. Now the next step in the MCDM methodology is to choose measures for your criteria. These measures would affect your decision outcome. So sometimes these measures lie on a natural scale. So for example, there are natural scales to measure weight, time, or currency. But for other criteria such as your own, there are not any natural measures, so you need to construct the measures in a way that they represent your concerns.

-I see, but do they all have to have numerical measures? Because when I think about it, I'm not sure I can define numerical measures for everything I care about. Take dependability, for example. How would you quantify that?

-No Samantha, you can also have categorical measures. For example, you can say that the level of dependability in a person can be low, average, or high.

-Good. That makes it easier to define these measures.

-Right. Now let's see what measures you have on your mind that can affect the decision outcome. So your first criterion was the impact of your roommate on your ability to maximize effective studying. So how do you think you can quantify that?

-Well, for one thing I would like my roommate to have the same major or similar majors as me. That way we can go to the same classes, schedule a time to study together, and we can help each other out.

-Right. So I would say the first measure is similarity of majors.

-Also, probably want to know how many hours a week does she study. That way I can plan my study time.

-Right. So we can say that the second measure is average hours of studying per week. So what about the second criterion, minimizing conflict? What measures do you think can affect that?

-Well, from my experience I think it's really important that my roommate cares about cleanliness. I've had roommates that were completely slobs, and it's just so difficult living with them.

-I totally agree. So I would say cleanliness is the first measure for this criterion. Do you have any other measures?

-I would say probably good communication skills as well. I think a lot of the potential problems can just be solved by easily communicating.

-Exactly. So communication skills would be another measure. Now the last criterion you had was maximizing fun. How do you think you can measure that?

-Well, I guess it'd fun if my roommate shared the same interests and hobbies as me.

-So can you be more specific?

-Yes. For example, I spend a couple of hours a day watching TV shows. It would be perfect if she likes those TV shows and we can match them together. That way she won't be annoyed by my TV watching habits.

-Right. So we can say that the measure could be number of TV shows in common.

-And the last one is party habits. I like partying and having friends over, and I would hope that she's OK with this.

-Cool. So the last measure is average number of parties per month.

-Sure.

-Can you come up with one or two measures for your own criteria and say if measures are numerical or categorical? Think about it, and we will be back in a minute to talk about how you can define appropriate ranges for your measures.

[MUSIC PLAYING]

OK. I'm sure each of you have come up with different measures to quantify your criteria. Please remember that the key point about MCDM methodology is that there is not just one right answer. Each individual will come up with different criteria and different measures that are important to them.

All right. Now you need to specify appropriate ranges for these measures. So this will later help you quantify your preferences. So sometimes you cannot define the ranges until you have gathered the data about the alternatives. But in the case of choosing a roommate, you already have in mind realistic values that can also work for you. So let's go to the first measure. Your first measure was similarity of majors. How do you think you can quantify that?

-Well I'm an accounting student, so I would like my roommate to also be an accounting student, or at least come from the same business school, something like marketing, finance, or management. And the least desirable case would probably her coming from a different school.

-OK. So this is a categorical measure, and you have three categories. The first one is accounting, the second one is not accounting but in the business school, and the third one is not in the business school. So we need to assign numerical values to each of these categories. So we assign 1 to the most preferred category. We assign a zero to the least preferred category. And here, we can assign a 0.5 to the middle category.

Now the next measure you had was average hours of studying per week. I think this is a numerical measure. What do you think is the appropriate range for that?

-Well I'd like my roommate to spend a reasonable amount of time studying every day, but I honestly don't want to live with someone who does nothing but study. So I guess for me a reasonable range would be between 18 and 30 hours a week. Also, probably like three to five hours a day.

-Good. So these cover the measures for maximizing effective studying. Now let's move on to the next criterion. It was minimizing conflict. And the first measure you had for that was cleanliness. I would say it's a categorical measure. What categories do you have in mind for cleanliness?

SAMANTHA: Well, I guess we can say a candidate can be either very tidy, tidy, or messy. Apparently, I like very tidy, so let's just assign that a 1. Tidy is 0.5, and messy is zero.

MADDIE: Good. OK so the next measure is communication skills, which I think is also a categorical measure. What categories do you have in mind for that?

-Well, I don't really know how to present these categories, but I guess we can just go with highly communicative, we could give a one. Moderately communicative, a 0.5, and not communicative, a zero.

MADDIE: Good. So we're done with the measures for minimizing conflict. The next criterion was maximizing fun, and the first measure you had for that was number of TV shows in common, which is a numerical measure. So what do you think is the appropriate range for that?

-Well, currently I'm following five TV shows, so I guess the reasonable range for that would be zero to 5, zero being the least desirable measure and 5 being the most desirable.

-Good. You actually have understood these ranges very well. So we only have one measure left, which is the average number of parties per month, and it's also a numerical measure. So do you have any appropriate range for that?

-Well, as I told you before, I do like to party and have friends over, but I also don't want it to get too out of control. So I think a reasonable range for that would be two to four parties per month, two being the most desirable and four being the least.

-All right, good job. We are halfway through the MCDM methodology. The next thing you need to do is to go and talk to these four girls again and gather data about their study habits, their major, their lifestyle. So for gathering data about the numerical measures, you can simply ask them the related questions. But for the categorical measures you can assign each candidate to each category based on your overall impression of them.

Now I'm going to ask you to define appropriate ranges for your own measures based on the instructions given in this video. We'll be back in a few minutes to see how Samantha collects data about the roommate candidates.

[MUSIC PLAYING]

All right, class. At this point you should have your own measures for choosing a roommate, and you should have the appropriate ranges for these measures. You can discuss your measures with your classmates and explain the rationale behind the ranges that you have defined. Now we are going to see what data Samantha has gathered about her roommate candidates.

So did you just talk to these four girls? Tell me what happened.

-Yes, Maddie. I actually got to talk to them about our lifestyles and our interests. I also gave them the list of my five favorite TV shows to see if we have any in common. This is how our discussions went.

-Hi, I'm Anna. I'm a sophomore in accounting. I plan to apply for graduate school after college, so I try to study hard to keep my grades high. I study about 27 hours a week. Looking at your list, I can see that we have one TV show in common. I'm not a big fan of TV shows. I prefer to read books and do paintings in my free time. I need to be honest with you. I'm a little bit messy. I used to make my mom so frustrated all the time. But I promise to do my best to improve. I don't usually throw parties myself, but I'd be OK with two parties per month.

SAMANTHA: This is how I summarized the data about Anna.

-Hi, I'm Laura. I'm a freshman music major. I also play in a band with my friends. Oh, I hope you don't mind me playing my guitar in the room. My major is not too demanding in terms of studying, so I guess I would need to study about 20 hours a week. Wow, it looks like we have two favorite TV show in common. It would be great to watch them together. Well, I guess I'm not the tidiest girl in the world. It's hard for me to be organized, but I will try my best to do my part in cleaning the room. By the way, I love partying. It would be awesome if we could do it every weekend.

SAMANTHA: This is how I summarized the data about Laura.

-Hello, my name is Emily. I'm a junior in accounting. I usually study about 20 hours per week. I really care about the cleanliness of my room. I usually clean every other day. I really prefer that my roommate is clean and tidy as well. I saw your list and we have three TV shows in common. I don't really have any special hobbies. I guess I just watch TV most of the time. You know, I'm not really a social person, but I want to change that. I'd like to find new friends. I'd really like to start socializing with the other students. I guess having parties is a good way to start that, so the ideal case for me is to have three parties per month.

SAMANTHA: This is how I summarized the data about Emily.

-Hi, I'm Lisa. I'm a sophomore in marketing. This is good that we both go to business school. I really like to go out with my friends and have fun, but that doesn't me I don't spend enough time studying every day. I guess I spend an average of 24 hours per week to study. I should say I'm not an obsessive cleaner, but I always try to keep the room clean. I get really disturbed when things are messy. Oh, this is nice. We have

two TV shows in common. I love to watch my favorite shows with my friends. I'm a big party girl. I think this is a big part of college life, so I love to party every weekend.

SAMANTHA: And this is how I summarized the data about Lisa.

-This is very good, Samantha. So you have gathered all the data you need to make your final decision. Now the question is, how can we compare these different roommate candidates based on the different measures we have, because these measures have different units?

In the next section, we will learn how to rescale our measures to a common unit so that all the measures would be comparable with each other. In the meantime, I would like you to think how you would go about gathering data for choosing your own roommate. What questions would you ask? We will be back in a few minutes.

[MUSIC PLAYING]

So here is the list of the data we have about the roommate candidates. As you can see, there is no roommate candidate that is the best in all the measures, so we need to compare them based on these measures to see who best meets Samantha's objectives.

-But Maddie, these measures are so different in nature, I don't know how I can compare them.

-Exactly. That's why the MCDM methodology has a very helpful technique to help with this problem. The solution is to rescale all the data to a common unit so that all the measures can be comparable. All right, now there are essentially three steps to rescale data to common units. Step one, assign one to the best value in the range. Assign zero to the worst value in the range. Step two, for the categorical data you can assign intermediate scores either proportionally or based on your own opinions and values. Now if you recall, we had assigned these scores proportionally for our categorical measures in section four. We consider the least desirable category for these measures to be equivalent to zero, the middle category to be equivalent to 0.5, and the most desirable category to be equivalent to one. This table shows our categorical measures in terms of common units.

Step three. For the numerical data there is a straightforward method for assigning intermediate scores proportionally. We can use this formula to make the conversion. Scaled score is equal to the absolute value of score minus least preferred score divided by the absolute value of most preferred score minus least preferred score. To show how this formula works, we will rescale the data we have gathered about Anna, and we will leave the rest to the class. Remember that Samantha had gathered the following data about Anna.

As I said before, Anna gets a score of one for the similarity of majors because she studies accounting. She gets a score of zero for cleanliness because she's probably messy. And she gets 0.5 for her communication skills because she looks to be moderately communicative. Now let's rescale her average hours of studying per week. Her score on this measure is 27. As Samantha has defined the appropriate range, the least preferred score for average hours of studying per week is 18, and the most preferred score is 30. Therefore the scaled score will be 0.75. This means that on a scale of zero to 1, with zero being the least desirable score and 1 being the most desirable score, Anna's score for her average hours of studying per week is 0.75.

For the number of TV shows in common, her scaled score is 0.2. Finally, her scaled score for the number of parties per month is 1. This table shows all the rescaled scores for Anna.

All right, class. Now you can rescale the rest of the data to a common unit. When we get back, I want you to have the results of your calculations in a table like this. When we come back, we will talk about how you can assign weights to each of your measures to reflect their relative importance to you.

[MUSIC PLAYING]

All right, class. If you have rescaled the measures correctly, your final table should look like this.

-So Maddie, I have all the rescaled scores for the roommate candidates. I guess we can just add up the totals and see who has the highest score?

-Well, that's not necessarily correct, Samantha. So for example, would you say you care equally about these measures? Like, if you wanted to assign weights to these measures, would you assign equal weights to them or are some of them more important to you than the others.

-No, you're right, Maddie. Not all of these measures are equally important to me, so how do I basically differentiate these measures when I want to calculate the total scores for each candidate?

-That's a good question, Samantha. So before you go ahead and calculate the total scores for these roommate candidates, you need to assign weights to the measures based on your preferences. So these weights actually reflect the relative importance of the measures to you. Actually I have created a table that can help us rank, order, and assign weights to the measures.

So as you can see, we have a list of the measures and their ranges. So the ideal case is that we have a roommate candidate that has the most preferred value in all the measures. But as you talk to them, you see that it's not the case. So why don't you look at the list and tell me which one of the measures you would most want to increase from the least preferred value to the most preferred value?

SAMANTHA: Well, I think I care the most about the similarity of majors. It really makes it convenient for me to study if my roommate studies accounting as well.

MADDIE: OK. So we can put 1 in the rank order in front of similarity of majors. Now go ahead and rank order the rest of the measures based on your preferences.

SAMANTHA: OK. Based on my experiences with previous roommates, I think communication skills are really important, so I'm going to rank communication second. And I can't really live with a slob, so I care a lot about cleanliness, and I'm going to rank that third. Then I would say the number of TV shows, fourth. And the number of parties per month, fifth. And I can live with anybody who studies at least three hours a day, so we'll rank that sixth.

-Good. Now the thing you need to do right now is to subjectively assign points from zero to 100 to each of the measures based on the rank order you already gave them. And in this process, you should always give 100 points to the most important measure, which here is similarity of majors. So I will go ahead and assign 100 to this.

Now the second one is communication skills. How important do you think this measure is to you in comparison to similarity of majors?

SAMANTHA: I would say it's almost as important, so I'll assign it 90 points.

MADDIE: Good. Now go ahead and assign points to these measures based on your preferences.

SAMANTHA: All right. I'm going to assign 85 points to cleanliness, since it's only slightly less important. However, everything else is a bit less important, so I'll assign 70 points to the number of TV shows and 60 to the parties per month, and then 50 to average hours of studying per week.

MADDIE: Good.

SAMANTHA: So here's what my table looks like so far. How do we calculate the weights now?

-OK, so it's very simple. First you add up all the points you have to calculate the total number of points for all the measures. Then you will divide the points for each measure by the total number of points. We will leave the rest of the calculations to the class. Please complete the table and assign weights to each measure. I also encourage you to think how you would rank order these measures based on your own preferences. When we get back, we will calculate the total scores for each roommate candidate, and we will finally choose the best roommate candidate for Samantha.

[MUSIC PLAYING]

MADDIE: All right, class. If you have calculated the weights for each measure correctly, your final table should look like this. Please note that the weights assigned to the measures should always sum up to 1. OK, Samantha. So now we have all the data we need to calculate the total scores for each roommate candidate based on your preferences.

-Great. What do I need to do now?

-It's very straightforward. You need the table where the common units were calculated and the table where the weights for each measure were calculated. Then the score for each roommate candidate on each measure is calculated using this formula. Score on each measure is equal to weight of the measure multiplied by the common unit score.

Now let's calculate all the scores for Anna. She got a score of 1 on similarity of majors. The weight for this measure was 0.22, so her weighted score for similarity of majors is 0.22. Her weighted score on average hours of studying per week is 0.082. Her weighted score on cleanliness is zero. Her weighted score on communication skill is 0.099. Her weighted score on number of TV shows in common is 0.031. Her weighted score on number of parties per month is 0.132. So this is how Anna's weighted scores look like.

Now I like to ask the class to complete the calculations and fill out this table with your results. After you calculate these scores for all the candidates, you should sum up the scores for each measure for each roommate candidate. This will yield the total score for each candidate, which will be a reference for making your decision. We will be back in a few minutes to see the results and help Samantha choose the best roommate based on the total scores.

[MUSIC PLAYING]

OK, we are back, and now it's time for Samantha to make the final decision about choosing a roommate. If you have calculated the scores for each candidate on each measure correctly, your final table should look like this.

All right, Samantha. Now look at the total scores for each candidate. Who has the highest total score among the four roommate candidates? I guess that would be Emily, because she had the highest scores in both similarity of majors and cleanliness, and both of those had high weights compared to the other measures.

-Right. So Emily and Anna had the two highest scores among all the four roommate candidates. And as you can see, they both got the same score on similarity of majors, but Emily got a very good score on cleanliness, whereas Anna got zero on cleanliness. And considering that cleanliness was the third most important measure for you, this gave Emily a very good advantage over Anna. Also she scored higher on the number of TV shows in common, so I would say Emily's advantage in these measures was so high that

it actually covered for her relatively lower scores on average hours of studying per week, communication skills, and average number of parties per month.

SAMANTHA: Wow, this was so interesting. Thank you so much, Maddie. You know what? My friend Peter is having difficulty picking a new car. He's narrowed it down to five choices. So I think I might show him this MCDM methodology, and maybe I can help him choose the best car based on his preferences.

-Oh, that's so exciting! Let me know about the result of his decision. I'm very happy that I could help you with this important decision.

-Sure. Now I'm going to go call Emily and let her know that she's become my new roommate. I'm so excited!

-Class, I hope you have found MCDM methodology as helpful as it was for Samantha. I suggest you use this method in a decision context that you're facing right now that involves multiple criteria. You can also share your experience in the decision making process with your classmates.

[MUSIC PLAYING]

-Hi, my name is Mahdokht Kalantari. I'm a PhD student in industrial engineering at Wayne State University. First of all, I would like to thank you for choosing our BLOSSOMS lesson about using multiple criteria to make decisions. All individuals, businesses, and government agencies face decision making on a routine basis. Sometimes these decisions are trivial and insignificant. In these cases, the choice can be easily made and there is no need for extensive analysis.

However, some decisions require hard thinking, and there are multiple criteria involved in the process of decision making. Having multiple criteria usually complicates the decisions because it is not easy to optimize all the criteria at the same time, and oftentimes trade-offs need to be made. For example, when you're deciding on a contractor to modify your house or apartment, you may have to trade off cost with the quality of the work. Or you may have to pay more to have the job done sooner. Therefore, in these situations, one can benefit from a structured and mathematical approach to help with these decisions.

In this BLOSSOMS lesson we will specifically talk about decisions that involve choosing from a limited set of realistic alternatives. Our goal is to introduce a very well-known decision making methodology called the Multi-Criteria Decision Making, or MCDM to the students. While the process is subjective and personal, it is systematically structured and requires deliberate and purposeful steps. At each segment of this BLOSSOMS module, we walk the students through one step of this method.

This lesson does not require any particular mathematical prerequisites. The techniques introduced in this lesson are straightforward and based on mathematical functions of scaling and calculating a weighted function. However, the structured approach is powerful and commonly used by companies and government organizations to make difficult decisions. It is important to remind the students that the multi-criteria decision making is all about personal preferences, and they should not expect a regular math lesson where there is one correct answer to each question.

Our suggestion is that before you start this BLOSSOMS lesson, you ask the students to form groups of two to do the activities. This will be helpful, because this module includes a lot of open ended discussions. Students can learn that other individuals can think differently when it comes to making the same decision. Working in teams will also be a good experience for the data gathering process and assigning weights to the measures.

In the first segment, we will open up the discussion by showing conversations between two college girlfriends, Maddie and Samantha. Samantha is facing the challenge of choosing a new roommate. She

argues that comparing roommate candidates is like comparing apples and oranges. We hope that using this idiom will show the class that we are talking about decision making contexts where one needs to choose among alternatives that are not comparable in an obvious way. We will provide examples of attributes that can be used to compare apples and oranges. We suggest that you close this section with a discussion about similar decision contexts. You can encourage the students to come up with other examples of decision contexts where they have multiple criteria that may conflict with each other.

For your information, we have uploaded a few abstracts of papers that can provide good examples of real world applications of MCDM methodology. By looking at these abstracts, we will be able to talk about business applications of MCDM as well as its individual applications. We have provided some examples of personal decisions that can benefit from MCDM methodology in the beginning of segment two.

In segment two, we introduced the MCDM technique, and we will talk about the first step of making a decision, which is choosing the criteria. Choosing the criteria is the first opportunity for students to add their own personal preferences into the mathematical model. The criteria represents the objectives of the decision, the things you would like to maximize or minimize in selecting one of the alternatives over all the others.

In segment two, some of the criteria for choosing a roommate in college are presented. For the activity of this section, students need to think of a situation where they want to choose a roommate in college. They should decide which factors are important enough for them to include in the decision. You need to emphasize that these criteria should be defined in a way that the students either want to minimize or maximize them. It is a good idea for teams to share their lists with a class as a whole. This will force each team to reexamine their list of criteria and decide whether or not it should be changed. In the real world, the first attempt at creating criteria may miss important concerns.

In segment three, we show how to come up with ways to measure the identified criteria. Each criteria needs at least one measure, but we encourage students to come up with two measures for each criterion to get a better insight into the MCDM technique. In this segment, you can talk about different types of measures and the distinctions between them with the students. We talk about numerical and categorical measures. People usually tend to pick measures that are easily quantifiable. However, many of the issues that really matter are not obvious to quantify. It would make no sense to leave out important concerns just because they're hard to quantify. That's why we like to highlight the importance of categorical measures.

Although these measures can be subjective, they can all be divided into meaningful levels. For example, the cleanliness measure can be divided into messy, tidy, and very tidy. As the activity of this segment, you can ask the students to come up with measures for their already identified criteria. Ask them to discuss their measures in teams and decide if their measures are numerical or categorical. Once again, sharing the measures with the whole class can lead to interesting discussions.

In segment four, we will discuss how to find appropriate ranges for each measure. There are usually two ways to define these ranges for measures. One way is to first gather data about the alternatives, check the data for the alternatives in each measure, and then choose the minimum and maximum values of alternatives as the range for each measure. The other way is to choose the ranges based on realistic ranges the decision maker will consider as acceptable. For example, Samantha would not consider a roommate who studies less than 18 hours per week or who partied more than four times per month.

For the activity of this segment, you can ask the students to define ranges based on their preferences for either their own measures or the measures that we have mentioned in this segment. You can ask them to discuss the reason for choosing the ranges in their groups.

In segment five we talk about gathering data about each alternative. A good activity for this section is to ask students in groups to interview each other. Students already have their own measures. They can interview their teammate as a roommate candidate to gather data about them. For categorical measures,

they will assign the candidate to a category under each measure. This activity helps students plan how they would go about asking questions and obtaining the required data to be used to assign values or categories for each measure for the specific candidate.

In segment six we teach the students how to rescale the data to a common unit. Usually the measures are very different in nature, and without a thoughtful and structured approach, it might seem impossible to compare the data for these measures. Rescaling the data to a common unit is the step that allows us to compare apples and oranges. This is the first step where we use mathematics to build a structure of the decision making model. The formula for rescaling numerical measures is pretty straightforward. In this segment, we have rescaled the data for the candidate Anna. You can ask the students to complete the calculations for the three remaining roommate candidates.

In the beginning of segment seven, we show the correct results of rescaled data. At this point, you can pause the video and ask the students to sum up the scores for each roommate candidate. By summing up the scores, Anna will have the highest total score among roommate candidates. You can encourage the students to think if Anna can be chosen as the best roommate for Samantha. This is where you need to introduce the idea of assigning weights to the measures. If all the measures are equally important to Samantha, then Anna would be the best choice. However, if she cares about some measures more than the others, she should take the weights of the measures into account before choosing her roommate.

In this section, we explain how to rank order the measures and assign weights to them. One thing that you need to emphasize is that the most important measure always get 100 points, and the rest of the measures are compared to the most important measure, and then scored accordingly. As the activity of this segment, we have asked the students to complete the weight calculations based on our numbers. You can also encourage them to discuss our measures in their teams and come up with their own ranking and weights.

In segment eight we first show the correct results of weights for each measure. Please note that we have limited our calculations to three decimal points, and that's why the sum of the weights do not quite add up to one, and the actual result based on our numbers is 1.001. We then show the formula for calculating the score of each roommate candidate in each measure. We perform the calculations for Anna, and we ask the class to complete the calculations for the rest of the candidates.

In segment nine we show the final results of candidate scores, and we wrap up the discussion by showing that Emily is the best roommate choice for Samantha. We also discuss the advantages and disadvantages of the two best alternatives. To help you better understand the process, we have also uploaded in the Additional Resources section the multi criteria decision making chapter of the book called, "When will we ever use this? Making decisions using advanced mathematics." This textbook was written by professors Thomas Edwards and Kenneth Chelst of Wayne State University, Detroit, Michigan in conjunction with a team of high school math teachers. This chapter presents three examples of MCDM, choosing a cellphone plan, a college, and a used car. It also has suggestions for homework assignments.

One good point about this BLOSSOMS lesson is that it is a mix of open ended discussions and concrete math, so it can very well lend itself to good class projects. Students can find other decision contexts that they may face in their personal lives, or they can redo the decision making process of finding a roommate based on their own criteria, measures, and weights. I would like to thank you again for choosing this BLOSSOMS module. I hope that you find multi-criteria decision making a useful topic for your class. Thanks, and good luck.

[MUSIC PLAYING]