# ENMA 421

# Case Study – Spring 2019

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# The Presented Case

You are moving to a new city in Virginia as a new graduate student. You do not know anyone in this city, and you do not have a car. While looking for a place to stay permanently during your grad school, you are now staying at a hotel near campus (walkable distance). You have $5000 saving money and will be paid $1,500 per month for a stipend (also 100% tuition fee waiver) as a graduate assistant. You want to make a decision as soon as possible because you do not want to keep paying for the hotel daily. Therefore, you went out and gathered information. From the website, the only public transportation is a bus service. The nearest grocery store is 1.5 miles away from the university (which will take about half an hour by a public transportation versus 5 minutes by a personal car). Followings are the options that you are considering:

**Job description:** After talking with your advisor, you learn that you might have to work late at night (around midnight) at least 3 nights per week.

**Accommodation information** (Assuming that all the alternatives are available to you):

| Candidate Apartment | Rent (net price per month)* | Distance from the university (miles) | Quality of neighborhood | Type** | Apartment size | Parking lot space | Public transportation accessibility |
|---|---|---|---|---|---|---|---|
| A | $425 | 0.5 | Good | Two-bedroom | Small | Small | Yes |
| B | $650 | 0.5 | Very good | One-bedroom | Medium | None | Yes |
| C | $400 | 1.5 | Good | Three-bedroom | Medium | Small | No |
| D | $850 | 20 | Excellent | One-bedroom | Large | Large | No |
| E | $500 | 3 | Poor | One-bedroom | Medium | Large | Yes |

* This is the amount of money that *only* you will have to pay

** You will have a chance to share an apartment with other people (random)

Rating scale (from best to worst):

Quality of neighborhood – Excellent, Very good, Good, Poor

Size – Large, Medium, Small

Parking lot space – Large, Medium, Small, None

The purpose of this case study is to demonstrate a thorough understanding of the material presented in the EMMA 421 Course. This case study will be completed using Decision Theory. Using this theory, I will identify the elements of a good choice.

- **Pr**oblem
- **O**bjectives
- **A**lternatives
- **C**onsequences
- **T**radeoffs

**PROACT**

With these elements identified, I will apply the knowledge learned in this course to make the best choice in regard to the given case.

To define the problem and objectives, the given circumstances must be evaluated thoroughly. In the given case, I am moving to a new city without a housing solution and with no personal transportation. I do have $5000.00 in savings and will make $1500.00 per month in my graduate student position. I am temporarily staying at a hotel that is within walking distance of the campus. However, I am not provided the cost of the hotel. Public transportation to the nearest grocery store is 1.5 miles at 30 minutes but only 5 minutes in a personal vehicle. My role will require late nights on campus and tuition is also noted as being no cost. With limited income, it becomes obvious that cost is a factor. As I will be working late nights, safety is a

factor. The time consumed by public transportation versus a personal vehicle should also be considered. With these items considered, my **PR**oblem is:

**"Maximize Housing Satisfaction"**

While this statement identifies the problem, it does not preselect any answer. With the problem now defined, the **O**bjectives must be defined. Looking at the factors identified, I can identify three fundamental objectives.

- **Minimize Cost**
- **Maximize Neighborhood Quality**
- **Minimize Commute Time**

  Public Transportation

  Personal Vehicle

  Distance from Campus

The **A**lternatives and **C**onsequences have been provided and placed in a table for this given case.

| Candidate Apartment | Rent (net price per month)* | Distance from the university (miles) | Quality of neighborhood | Type** | Apartment size | Parking lot space | Public transportation accessibility |
|---|---|---|---|---|---|---|---|
| A | $425 | 0.5 | Good | Two-bedroom | Small | Small | Yes |
| B | $650 | 0.5 | Very good | One-bedroom | Medium | None | Yes |
| C | $400 | 1.5 | Good | Three-bedroom | Medium | Small | No |
| D | $850 | 20 | Excellent | One-bedroom | Large | Large | No |
| E | $500 | 3 | Poor | One-bedroom | Medium | Large | Yes |

I must start to narrow this list. The first method to accomplish this is to check for any dominant or dominated alternatives. This is simply to determine if any one alternative is the best in every category or if any alternative is the worst in every category. I will do this by placing a star on the best in each category and an X on the worst in each category.

| Candidate Apartment | Rent (net price per month)* | Distance from the university (miles) | Quality of neighborhood | Type** | Apartment size | Parking lot space | Public transportation accessibility |
|---|---|---|---|---|---|---|---|
| A | $425 | 0.5 | Good | Two-bedroom | Small ✖ | Small | Yes |
| B | $650 | 0.5 | Very good | One-bedroom | Medium | None ✖ | Yes |
| C | $400 ★ | 1.5 | Good | Three-bedroom | Medium | Small | No |
| D | $850 ✖ | 20 ✖ | Excellent ★ | One-bedroom | Large ★ | Large | No |
| E | $500 | 3 | Poor ✖ | One-bedroom | Medium | Large | Yes |

It becomes obvious after placing a few stars and X's that there is no outright dominant or dominated alternatives. Another technique is pair-wise comparison. I can compare any two alternatives against each other. If any alternative is found to be worse or equal in every category to its compared alternative, it can be eliminated even if it is not outright dominated. If I apply pair-wise comparison to these alternatives, I still find that I cannot eliminate any of the alternatives.

The next term to identify - (the T in PROACT), is tradeoffs. Using the even swap method, I can begin to equalize the categories and thus eliminate the category from the decision process.

The steps for the even swap method are:

1. Determine the change necessary to cancel out an objective.
2. Assess what change in another objective would compensate for the needed change.
3. Make the even swap.
4. Cancel out the now irrelevant objective
5. Eliminate any dominated alternative.

I will focus on "**Quality of Neighborhood**" first with this technique. With late-night safety being a priority, I am willing to make the following tradeoffs:

1. An increase from Good to Very Good for an increase in cost of $50
2. A decrease from Excellent to Very Good for a reduction in cost of $50
3. An increase from Poor to Very Good for an increase in cost of $100

Table with changes:

| Candidate Apartment | Rent (net price per month)* | Distance from the university (miles) | Quality of neighborhood | Type** | Apartment size | Parking lot space | Public transportation accessibility |
|---|---|---|---|---|---|---|---|
| A | $475 | 0.5 | Very Good | Two-bedroom | Small ✖ | Small | Yes |
| B | $650 | 0.5 | Very good | One-bedroom | Medium | None ✖ | Yes |
| C | $450 ★ | 1.5 | Very Good | Three-bedroom | Medium | Small | No |
| D | $800 ✖ | 20 ✖ | Very Good | One-bedroom | Large ★ | Large | No |
| E | $600 | 3 | Very Good | One-bedroom | Medium | Large | Yes |

Quality of Neighborhood is now irrelevant and can be removed from the table. There are still no dominant or dominated alternatives. I can apply the even swap method to "**Apartment Size**" as well with the following tradeoffs:

1. An increase from small to medium for an increase in cost of $25
2. A decrease from large to medium for a cost savings of $25

| Candidate Apartment | Rent (net price per month)* | Distance from the university (miles) | | Type** | Apartment size | Parking lot space | Public transportation accessibility |
|---|---|---|---|---|---|---|---|
| A | $500 | 0.5 | | Two-bedroom | Medium | Small | Yes |
| B | $650 | 0.5 | | One-bedroom | Medium | None | Yes |
| C | $450 | 1.5 | | Three-bedroom | Medium | Small | No |
| D | $775 | 20 | | One-bedroom | Medium | Large | No |
| E | $600 | 3 | | One-bedroom | Medium | Large | Yes |

With the changes above, there are still no dominant or dominated alternatives. Apartment size is now irrelevant and can be removed from the table. I can apply the even swap method to "**Parking Lot Space**" with the following tradeoffs:

1. An increase from small to medium for an increase in cost of $25
2. An increase from none to medium for an increase in cost of $50
3. A decrease from large to medium for a cost savings of $25

| Candidate Apartment | Rent (net price per month)* | Distance from the university (miles) | Type** | Parking lot space | Public transportation accessibility |
|---|---|---|---|---|---|
| A | $525 | 0.5 | Two-bedroom | Medium | Yes |
| B | $700 | 0.5 | One-bedroom | Medium | Yes |
| C | $475 | 1.5 | Three-bedroom | Medium | No |
| D | $750 | 20 | One-bedroom | Medium | No |
| E | $600 | 3 | One-bedroom | Medium | Yes |

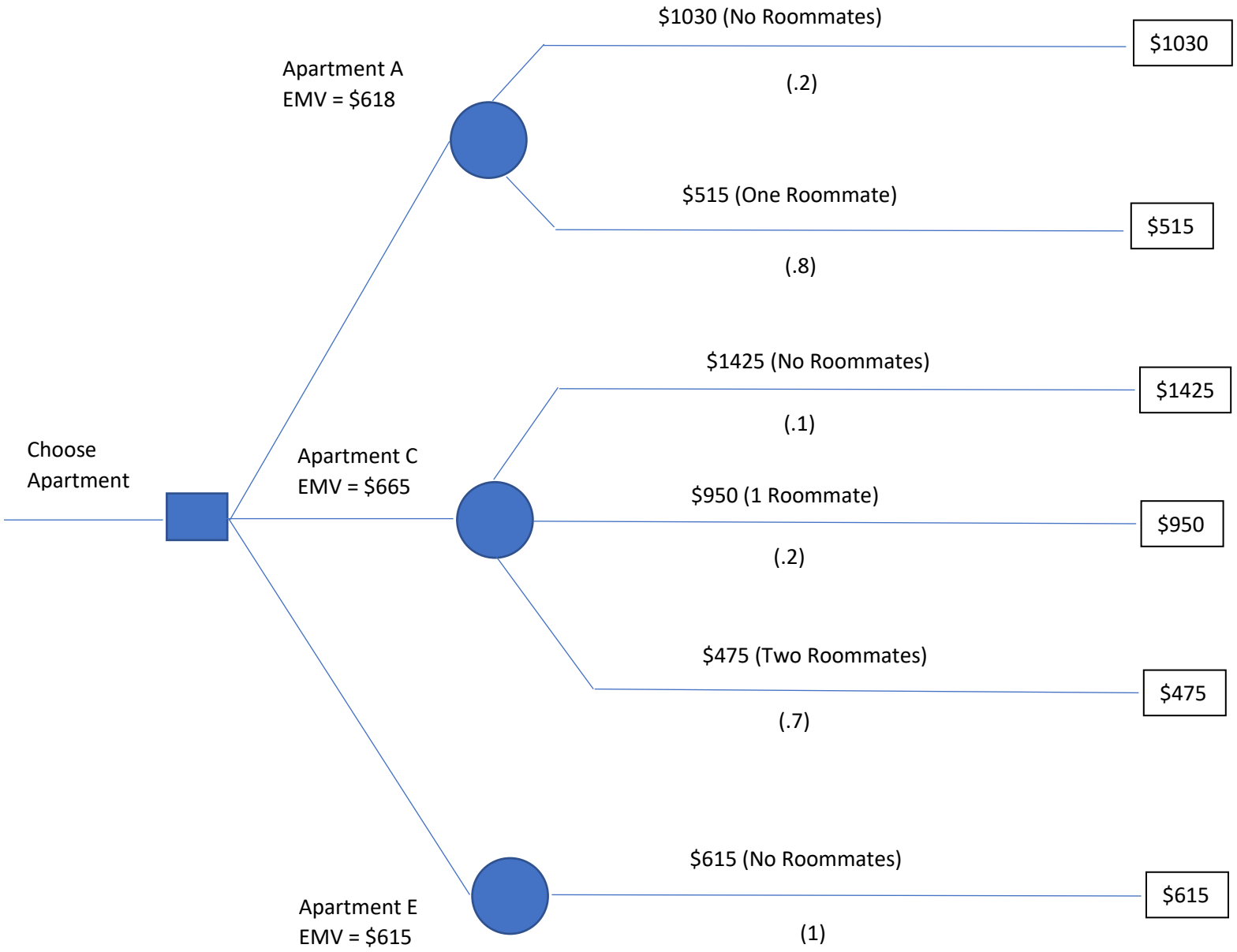
With "Parking Lot Space" now irrelevant, it can be eliminated from the table. I find myself conflicted in this choice as there is no parking space at apartment B. This could be viewed as requiring the use of public transportation but in this case, I will assume that this is a difficulty that was absorbed in the tradeoff and there is public parking close by. Alternative D can now be eliminated because it is worse or equal to alternative B. Finally, I can apply the even swap method to "Distance from the University" with the following tradeoffs:

1. An increase from .5 miles to 1.5 miles for a decrease in cost of $10
2. A decrease from 3 miles to 1.5 miles for an increase in cost of $15

| Candidate Apartment | Rent (net price per month)* | Distance from the university (miles) | Type** | Public transportation accessibility |
|---|---|---|---|---|
| A | $515 | 1.5 | Two-bedroom | Yes |
| B | $690 | 1.5 | One-bedroom | Yes |
| C | $475 | 1.5 | Three-bedroom | No |
| E | $615 | 1.5 | One-bedroom | Yes |

"Distance from the University" is now irrelevant and can be eliminated from the table. Alternative B can now be eliminated as it is worse or equal to alternative E in the remaining categories. I am now left with a one, two, and a three-bedroom alternative.

Before I eliminate any other alternatives, I need to address some uncertainties and risks. There is uncertainty with each of the multiple bedroom apartments. There is also risk if either a roommate cannot be found or a roommate leaves. This would increase the cost for the apartment. To accomplish this, I will start by creating a decision tree. The tree will include the risk for apartment A and C of having less than full occupancy. I will use Expected Monetary value (EMV) to evaluate this risk using probability % that I made up for this case. The probabilities are small but will impact the EMV.


$1030 (No Roommates)
$1030
Apartment A
EMV = $618
(.2)
$515 (One Roommate)
$515
(.8)
$1425 (No Roommates)
$1425
(.1)
Choose
Apartment
Apartment C
EMV = $665
$950 (1 Roommate)
$950
(.2)
$475 (Two Roommates)
$475
(.7)
$615 (No Roommates)
$615
Apartment E
EMV = $615
(1)

With the probabilities I assigned, the decision tree would certainly eliminate Apartment C. While it was the cheapest, the risk of increased cost due to roommate not being available or not paying drives the EMV up. The EMV difference between A and E is only $3. Strictly by EMV, apartment E would be chosen. However, with the EMV this close, I personally would consider this even and most likely base the decision on whether I wanted a roommate or the quality of neighborhood.

There is a linked decision in this case, whether to buy a personal vehicle or rely on public transportation. Alternative C has no public transportation. This would have required the immediate purchase of a vehicle. With the other remaining alternatives all having public transportation, the purchase of a vehicle would not be required but would reduce commute times versus public transportation. The linked decision could be postponed in order to gain more information about the public transportation and my personal needs. This could have been tied in to the decision tree but I felt it would mix recurring cost and one-time cost. It could also be tied to commute time

Using the tools learned in the course, I was able to come to a smart choice in this case study. Through the use of tradeoffs and evaluating uncertainties and risks, I narrowed down my list of alternatives. The decision tree, the final step in this case, showed a small $3 difference in EMV with Alternative E over Alternative A. As I previously mentioned, I feel this to be a tie and would most likely choose A due to quality of neighborhood. Perhaps I should have added more value to the quality of neighborhood when performing the even swap method. Overall, I do feel this is a good choice. It is close to campus and has both parking and public transportation.

This case study added a level of difficulty over the classwork thus far in that the tradeoffs and other variable were left to me to decide. This is more real world, but it does add complexity and to be honest some personal uncertainty about these values and the desire to be correct. I feel these techniques will become more comfortable with use but as described in the course, there are many traps and pitfalls that will be easy to fall into as a new practitioner of these methods.