DECISION SCIENCE FOR EVERYDAY LIVING

How to make the best decisions to become wealthier, have partner happiness, and be a valued employee.

DECISION MAKING

- We all make countless decisions every day
- On the important ones, do we make the best decisions – ones that will likely end up with a favorable outcome?
- Or do we decide and simply hope it will be all right?
- How can we improve our chances that the decision we make has a favorable outcome?

DECISION SCIENCE – A WAY OF MAKING BETTER DECISIONS

- Decision Science is taught in University MBA programs to help new leaders make or influence key decision-makers like company Presidents & CEOs to make better decisions
- It is a structured decision-making process with ways to show relationships, alternatives & potential outcomes
- Uses concept of "expected value"
- Improves chance of a good outcome

Its principles are useful for all of us to make better decisions

THIS CLASS WILL:

- Show you how to improve your chances of a good outcome
- Help you understand decision traps that can lead you to make the wrong or inferior decision
- Help you make decisions where there are a lot of considerations
- Help you get buy-in from others who have “skin in the game”

EXERCISE #1

Who wants to make a bet?

I have a normal die with six sides having 1,2,3,4,5, and 6 dots)

It costs $1 to play and if you pick the right number of dots, I will pay you $2

Any body interested in playing?

EXPECTED VALUE

Expected value is the value a decision outcome would average if the same decision was made repeatedly with the same assumptions. So, let's see what that means….

A six-sided unloaded die will end up with a specific number of dots only one in 6 times on average or stated differently only 16.7% of the time. 16.7% is the probability of a favorable outcome

If you bet $1 to possibility get $2 your expected value each time you play would be $2 x 0.167 -1 or you should expect to lose 67 cents every time you play.

-$0.67 is the expected value of this game. ☹

GOOD DECISIONS AND GOOD OUTCOMES

- Was the decision to play a good or poor decision from a financial standpoint and why?
- What payoff would have neutral decision to play? i.e. an expected value = 0
- If a person played the game with a smaller than a neutral payoff and won money, would that have been a good decision to play?
- What minimum payoff would have been a good decision to play? If a person played the game and lost their money would it have been a bad decision to play?

EXPECTED VALUE AND DECISION MAKING

- To the extent you can afford to make a decision whose outcome has a positive expected value, it will be a good decision. Keep in mind that you can still have a bad outcome. On average, you should have a favorable outcome.
- You could have a good outcome even though the expected value is negative, but it would be a bad decision and you will likely lose money on average.
- Investing long term in a diversified portfolio of stocks & bonds would be an example of a good decision based on a positive expected value.
- Going to a casino or playing the lotto/buying scratch-offs would be an example of a bad decision due to a negative expected value

EXPECTED VALUE SUMMARY

- Expected value is the probabalized outcome
- Making a decision that has a positive expected value is good
- Making a decision that has a negative expected value is bad.
- It is possible to have a bad outcome with a positive expected value and a good outcome a negative expected value.
- Casinos and lotteries count on a positive outcome to reinforce bad decision-making so they can make money in the long haul while you lose money.

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Week 2 – Decision traps

LESSONS LEARNED FROM WEEK 1

- Expected value is the probabalized outcome
- Making a decision that has a positive expected value is good
- Making a decision that has a negative expected value is bad.
- It is possible to have a bad outcome with a positive expected value and a good outcome a negative expected value.
- Casinos and lotteries count on a positive outcome to reinforce bad decision-making so they can make money in the long haul while you lose money.

SO…WITH THAT REVIEW IN MIND…

Who wants to bet $1 towards a $2 payoff picking a number on a die?

DECISION TRAPS

- There are several decision traps that can influence your thinking causing you make a bad decision.
- The one we just discussed is making a previous bad decision like buying a scratch-off that had a good outcome ($). This can reinforce bad decision–making (buying more scratch-offs) leading to losing money over the long haul.
- What are other examples of bad decision-making that can have a favorable or neutral outcome leading to repeated bad decision-making and future unfavorable outcomes?

OTHER DECISION TRAPS

Key to making good decisions is researching the opportunity or problem and gathering data. Besides laziness to do the research and gather the data, the following decision traps can make one feel the research / data gathering is not necessary…

- Overconfidence
- Bias
- Using Rules of thumb
- Shooting from the hip
- "Groupthink"
- Focusing on only a portion of the data

OVERCONFIDENCE & BIAS

These are quotes from smart people or good companies:

"We don't like their sound, and guitar music is on the way out."
--Decca Recording Co. rejecting the Beatles, 1962. Current worth >$1B

"Everything that can be invented has been invented."
--Charles H. Duell, Commissioner, U.S. Office of Patents, 1899.
(How many things can you name pre-1900?)

"Heavier-than-air flying machines are impossible."
--Lord Kelvin, president, Royal Society, 1895. (Airplanes & rockets are impossible?)

"Who the hell wants to hear actors talk?"
--H.M. Warner, Warner Brothers, 1927. (*He produced silent movies.)*

"640K ought to be enough for anybody."
-- Bill Gates, 1981 *(You have ~100,000 x more in your phone and need it)*

OVERCONFIDENCE & BIAS

"So we went to Atari and said, 'Hey, we've got this amazing thing, even built with some of your parts. What do you think about funding us? Or we' ll give it to you. We just want to do it. Pay our salary, we'll come work for you.' And they said, 'No.' So then we went to Hewlett-Packard, and they said, 'Hey, we don't need you. You haven't got through college yet.'"

--Apple Computer Inc. founder Steve Jobs on attempts to get Atari and H-P interested in his and Steve Wozniak's personal computer. (Apple is worth $2,000,000,000,000 today)

OVERCONFIDENCE & BIAS

"The concept is interesting and well-formed, but in order to earn better than a 'C,' the idea must be feasible."

--A Yale University management professor in response to Fred Smith's paper proposing reliable overnight delivery service. (Smith went on to found FedEx)

"This 'telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us."

--Western Union internal memo, 1876. *(Have you ever seen a telegraph or seen a telegraph key?)*

We can laugh at all these examples today but what are we hearing and seeing now which will be as absurd in the future and might contribute to poor decision-making?

"Groupthink" & Focusing on only a portion of the data

Group think – Sometimes one or two dominate individuals plant an idea and the group takes off with it without exploring other ideas Do you have any examples you have seen of this?

"Focusing on only a part of the data" – The Space Shuttle Challenger disaster is an example where only part of the data was looked at prior to launch on a cold January morning. The rocket blew up 73 seconds into its flight killing 7 people. Had all the data of the prior launches been looked it, a recommendation not to launch at the current temperature would have likely been made. The decision also had "group think" bias.

EXERCISE 2

Please do not use your phone or computer to look up answers. <u>This exercise is to help you understand how you think</u>, not what you know or can find out.

I am going to ask 10 questions and I want you to:

1. answer by thinking and writing down what it is not likely to be less than (i.e. < 1 in 10 chance)
2. then write down what is it is not likely to be greater than (< 1 in 10 chance)
3. then finally based on those two numbers write down what you think will be close to the correct answer

Summary - Week 2

- If you don't gather information for the decision you are making, you can fall into a number of decision traps including:
  - Overconfidence
  - Bias
  - Using Rules of thumb
  - Shooting from the hip
  - "Groupthink"
  - Focusing on only a portion of the data
- Use the insight you gained from Exercise 2 regarding how you think to broaden or shrink the range of possibilities in your mind.

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Week 3 – Framing an opportunity or problem

Weeks 1 & 2 Review

- Expected value is the probabalized outcome
- Making a decision that has a positive expected value is good
- Making a decision that has a negative expected value is bad.
- It is possible to have a bad outcome with a positive expected value and a good outcome a negative expected value.
- If you don't gather information for the decision you are making, you can fall into a number of decision traps
- Use the insight you gained from Exercise 2 regarding how you think to broaden or shrink the range of possibilities in your mind.

FRAMING A PROBLEM OR OPPORTUNITY

- As stated in the beginning, we all make countless decisions everyday. Most have minor investment (time or money) and consequences.
  - You are thirsty. "Hmmm what are my options close at hand? I like these two drinks. Hey this one is cheaper… "
- Sometimes the opportunity or problem is much bigger and may even feel unmanageable.
  - Should I go to college, trade school, or simply start work when I graduate high school?
  - Should I move out from home and get an apartment and get a roommate to help pay rent?
  - Should I take this or that job?
  - Should I buy a car and if so what kind / which one?

FRAMING A PROBLEM OR OPPORTUNITY

- Those last questions are tough to simply run though in your head. It would give me a headache! ☹ That is where providing some structure and using some decision science tools can help.
- The first step is to frame the problem in writing.
  - Write out a problem or opportunity statement
  - What are the boundaries?
  - What are the alternatives you are willing to consider?
  - How will you measure success?
- Keep in mind…
  - Too tight of constraints limits alternatives and may sub-optimize your outcome
  - Too broad of framing may make the problem unmanageable and take too much time to solve

PROBLEM STATEMENT AND BOUNDARIES

- Writing a good problem or opportunity statement is the best way to start towards making a decision with a good outcome
- It is not uncommon that your problem statement may change as you gather more information and develop different perspectives
- Is the question "Should I go to college, trade school, or simply start work when I graduate high school?" a good problem or opportunity statement? Thoughts?

PROBLEM STATEMENT AND BOUNDARIES DEVELOPMENT

"Should I go to college, trade school, or simply start work when I graduate high school?"

- has a huge number of possible scenarios and outcomes
- it is not clear what success is

How do we narrow the question to a manageable decision without possibly losing a possible great outcome?

What are questions you might ask or information you might seek out?

PROBLEM STATEMENT AND BOUNDARIES DEVELOPMENT

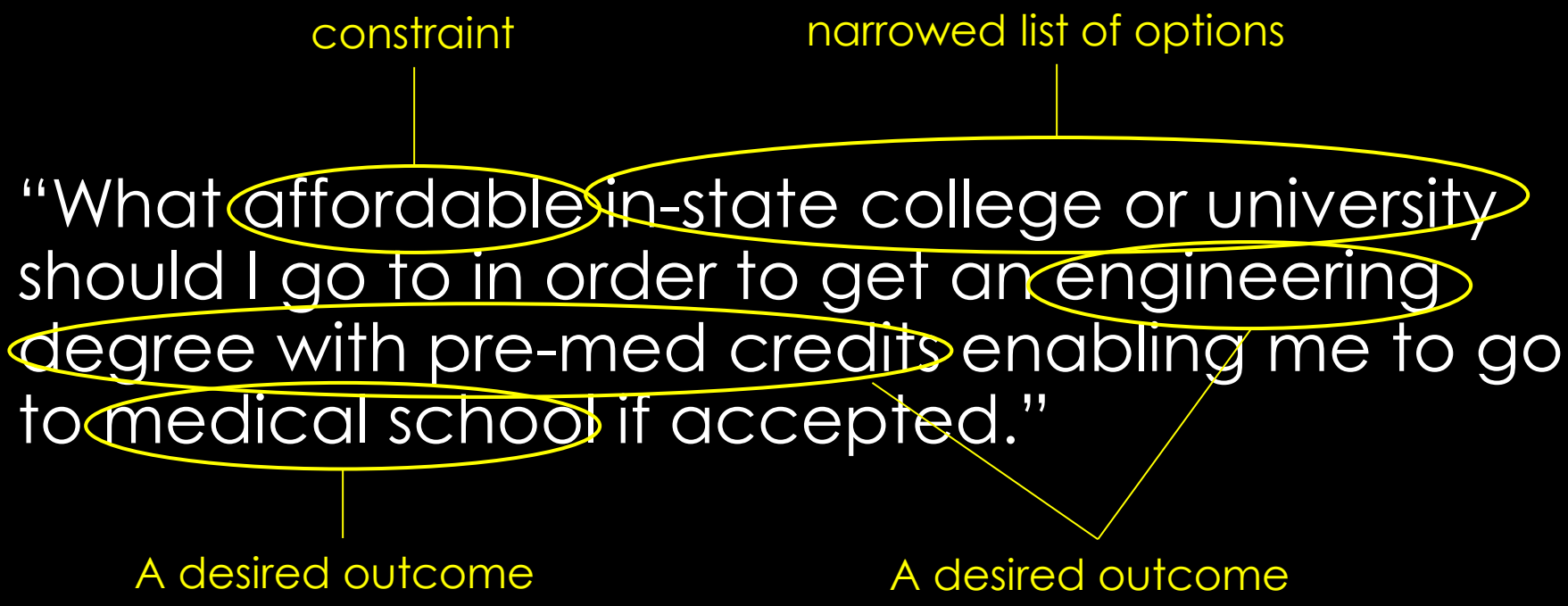
Possible questions:

1. What do I think I would like to do for my career? Why?
2. What am I good at? (i.e. What are my skills?)
3. Have I accomplished in school what is required to go to college?
4. What barrier(s) do I have to achieving my desired outcome?
5. What resources do I have or possibly can get to achieve my desired outcome?
6. Are others a stakeholder in my decision? (e.g. Parents? Significant other?)
7. Other questions?

PROBLEM STATEMENT AND BOUNDARIES - EXAMPLE 1

1. What do I think I would like to do for my career? Doctor or Engineer
2. What am I good at? (i.e. What are my skills?) Math, science, making and repairing things
3. Have I accomplished in school what is required to go to college? Have good grades and scored well on SAT, involved in sports and other school activities
4. What barrier(s) do I have to achieving my desired outcome? $, possibility not being accepted into medical school upon college graduation.
5. What resources do I have or possibly can get to achieve my desired outcome? Some savings and can work part time, possible academic and athletic scholarships, education loan(s), parents said they will help fund.
6. Are others a stakeholder in my decision? (e.g. Parents? Significant other?) Parents and institutions or people willing to provide scholarships.
7. Other considerations?
    1. In-state education is significantly cheaper than out of state.
    2. Medical school is very difficult to get into and will cost significantly more money.

EXAMPLE 1 – PROBLEM STATEMENT



With only 3 options available that meets this criteria we can be very effective using decision science tools to make the best decision.

PROBLEM STATEMENT AND BOUNDARIES - EXAMPLE 2

1. What do I think I would like to do for my career? Something in healthcare
2. What am I good at? (i.e. What are my skills?) Good with interacting with a diverse set of people, writing skills, OK in math and science
3. Have I accomplished in school what is required to go to college? Have above passing grades, involved in school activities
4. What barrier(s) do I have to achieving my desired outcome? Money is a big issue!
5. What resources do I have or possibly can get to achieve my desired outcome? Some savings and can work part time, possibly get scholarship(s), education loan
6. Are others a stakeholder in my decision? (e.g. Parents? Significant other?)
7. Other considerations?
    1. I understand some hospitals do in-house training for Patient Care Assistants and pay you at the same time
    2. Parents say I can live at home while in school or while training somewhere

EXAMPLE 2 – PROBLEM STATEMENT

Boundaries (constraints)

Boundaries (narrowed list of options)

"What affordable local 2 yr. college, trade school or place of employment that offers training or education subsidy should I go to or be employed by in order to have a career in healthcare

A desired outcome

What is a concern with this statement? How can this statement be improved? Should the initial focus be something else?

PROBLEM STATEMENT AND BOUNDARIES

As mentioned earlier, it is not uncommon that your problem statement may change as you gather more information and develop different perspectives.

In Example 2, the problem statement still had too many alternatives and scenarios to be manageable because "healthcare" is too broad. We need to make a decision as to what type of healthcare career we should pursue first, then we can choose what is the best way to become qualified.

We will discuss a new problem statement and how to link two decisions like "what career should I pursue" and "how should I get qualified for it" later in this course.

HOMEWORK

Take a concern of yours that you need to make a decision about and develop a problem statement.

If you don't mind, please consider sharing at our next class.

DECISION SCIENCE

Week 4

- *Homework review*
- *Problem statement replacement / improvement / revision*
- *Alternative development and evaluation*
- *Getting Stakeholder buy-in*

Weeks 1, 2, & 3 Review

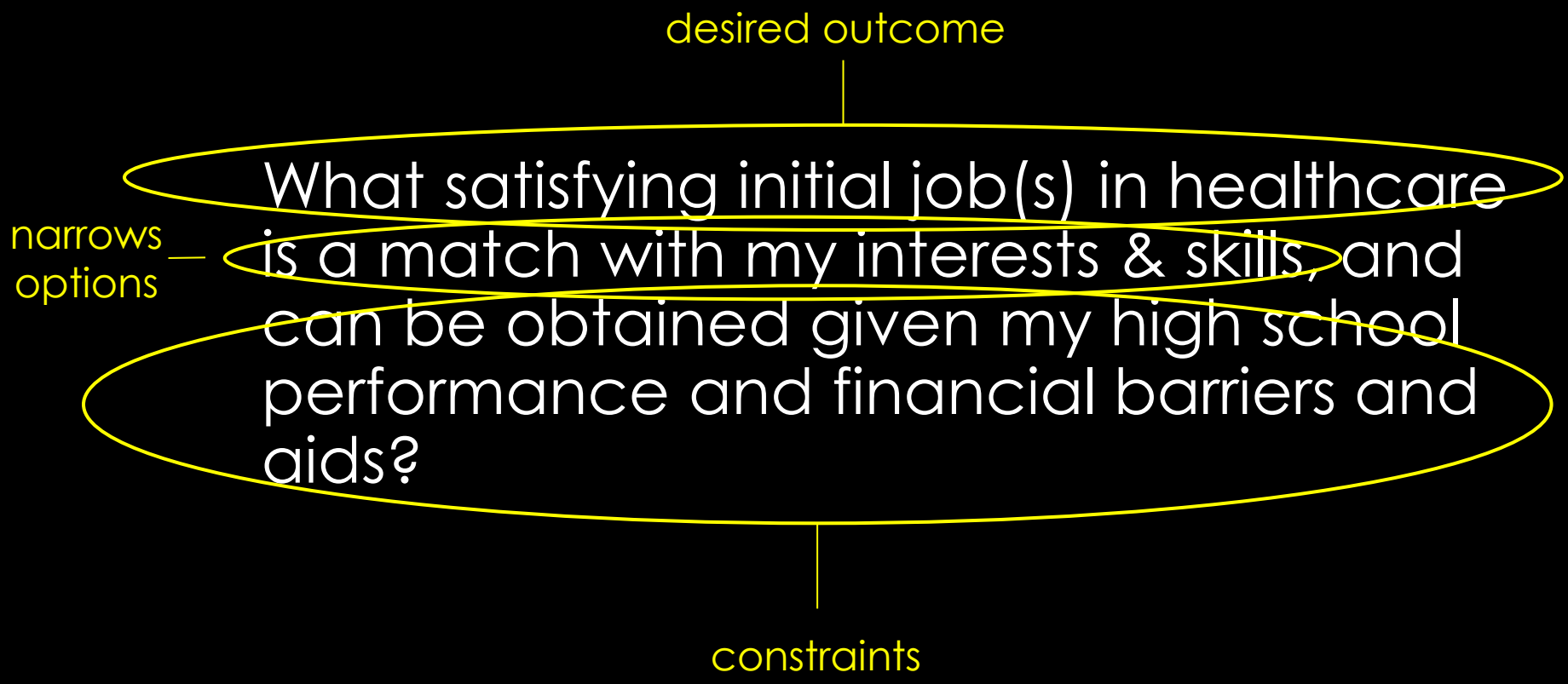
- Expected value is the probabilized outcome
- Making a decision that has a positive expected value is good
- Making a decision that has a negative expected value is bad.
- If you don't gather information for the decision you are making, you can fall into a number of decision traps
- Use the insight you gained from Exercise 2 regarding how you think to broaden or shrink the range of possibilities in your mind.
- Develop a problem or opportunity statement to frame the problem and understand the boundaries

BACK TO OUR CAREER AND EDUCATION / TRAINING DECISIONS

Let us start where we left off with Example 2 from Week 3. If you recall we needed to explore what careers within the healthcare that we might be interested in and decide on that before we can really choose how to achieve the qualifications for the job.

So, what might be a good problem statement to narrow the list of healthcare careers to something more manageable?

A SAMPLE PROBLEM STATEMENT FOR MY CAREER CHOICE



OPTION DEVELOPMENT & EVALUATION

- Use resources (internet, mentors, professionals in the careers you are thinking about, etc. to gather information regarding options (alternative careers in this case)
- Use the information you gathered to develop a list of options you want to explore further
- Gather as much information on the options you have chosen as you can given your time constraints and the importance of the decision
- If you find another an option that seems attractive while gathering the additional information, add it to your list ☺
- Organize your information in a table (preferably a spreadsheet)

OPTION DEVELOPMENT – ORGANIZING YOUR INFORMATION

Role	Length of Training	Cost of Training	General Duties (duties may be expanded)	Salary Hourly range Average annual in Florida
CMA Certified Medical Assistant	9 months-2 yrs Dependent on program	$1,200-$4,200 or On-the-Job	Greet, interview patients Take blood pressure, temp, heart rate Clerical answer phones, filing, scheduling Document in patient's medical record Order and stock supplies	$10-$18/hr. FL Avg $34,465/yr.
CNA Certified Nursing Assistant	4 to 6 weeks	$500-$2,500	Patient care including bath, personal hygiene, blood pressure, temp, heart rate, respirations, Changing linens, ambulation, assist to bathroom, Document in patient's medical record.	$10.60-$16/hr. FL Avg. $30.860/yr.
Dental Hygienist	2 years	$850-$7,500	Take x-rays, clean teeth, Educating patients, Sterilizing instruments, assisting dentist	$15.91-$30/hr. FL Avg. $61,860
LVN/LPN Licensed Vocational/ Practical Nurse	12 months	$4,000-$15,000	Distribute patient meds Document in patient's medical record Care of patient drains, wounds, dressings, etc	$16.15-$26.28/hr. FL Avg. $39,915/yr.

TANGIBLES & INTANGIBLES

- Tangibles here means money.
- Intangibles are considerations that cannot be measured in $
- To the extent you can monetize an intangible to make it tangible, do it. It simplifies the analysis and gives you a clearer view.
  - *An example might be buying a car. You may feel (intangible) that one is going to cost more in maintenance than the other. Gather additional data if you can to actually convert that feeling to $. Once converted it simply gets added to other costs and you can forget thinking about it any further.* ☺
- Net Present Value (NPV) is a way to take various cashflows occurring at different times and giving you a single net cost or net income for each option.

INTANGIBLES DEVELOPMENT

- Looking at the information you collected on your options, what are intangible considerations you might consider?
  - Do some careers seem more satisfying than others?
  - Do you want to have more or less patient contact?
  - How do you feel about working in various people's mouth day in and day out.
  - How do you feel about dealing with bodily waste?
  - Are you interested in advancement and is there a career path available starting with the option?
  - What are some others you can think of?

INTANGIBLES ANALYSIS

- Start an intangibles spreadsheet
- For each intangible, assign an importance weight on scale like1-5 with the more important items getting the highest score.
- Next look across each option with regards to an intangible and rate each on a scale like 1-5 with 5 being the most favorable. Do this for all options and intangibles.
- Next you will multiply each rating by its importance and add them together for each option.
- Finally, you compare the sums for each option to see how each option scores based on intangibles

INTANGIBLES ANALYSIS EXAMPLE

Healthcare Job Intangibles									
		Your rating				**Importance times rating**			
Intangible	**Importance**	Option 1	Option 2	Option 3	Option 4	Option 1	Option 2	Option 3	Option 4
	(scale 1-5) (5 is most important)	(scale 1-5) (5 is most favorable)	(scale 1-5) (5 is most favorable)	(scale 1-5) (5 is most favorable)	(scale 1-5) (5 is most favorable)				
Intangible #1	3	1	5	3	2	3	15	9	6
Intangible #2	1	3	2	5	4	3	2	5	4
Intangible #3	5	2	3	2	2	10	15	10	10
Intangible #4	2	1	2	2	3	2	4	4	6
						18	36	28	26

Step 1
List intangibles

Step 2
Weigh importance

Step 3
Rate option by intangible

Step 4
Multiply importance by rating

Step 5
Sum each column to provide and overall Intangibles score for each options

MAKING THE DECISION

We now compare the overall tangible benefit (NPV) with the overall intangible score.

For the following example we will use average salary in lieu of NPV. (This is not correct, but it gives a simple illustration and probably still leads to the correct decision in this instance. If you know how to calculate an NPV, then that would be the appropriate approach.)

	Option 1	Option 2	Option 3	Option 4
	CMA Certified Medical Assistant	CNA Certified Nursing Assistant	Dental Hygienist	LVN/ LPN Licensed Vocational / Practical Nurse
Tangible summary:	$ 34,465	$ 30,860	$ 61,860	$ 39,915
Intangible summary score:	18	36	32	26

This option falls out

Highest Intangible Score

2nd Highest Intangible Score but significantly higher tangible

This option falls out

Now you look back at your intangibles scoring and see that it was only intangibles 1&3 that drive the difference so now it is simply a question of are those two items worth the difference in salary ($31,000/yr.)?

BENEFITS OF THIS APPROACH

- It simplifies a decision with multiple options and lots of considerations (tangibles and intangibles)down to typically 2-3 options and only a couple of considerations that are important. This allows the decision-maker to "get their head around it"
- Once you have completed this analysis, it is very easy to update with new information or options
- It helps with getting other stakeholder(s)on board with the decision because you:
  - have everything clearly laid out to present to someone or a group
  - can involve stakeholder(s) in the process so that they can provide options, considerations (tangibles and intangibles), input into weighting importance and option rating. This kind of involvement is really important when stakes are high and views are diverse.

DECISION SCIENCE

WEEK 5

- *Linking decisions*
- *Decision trees & uncertainty*

LINKING DECISIONS

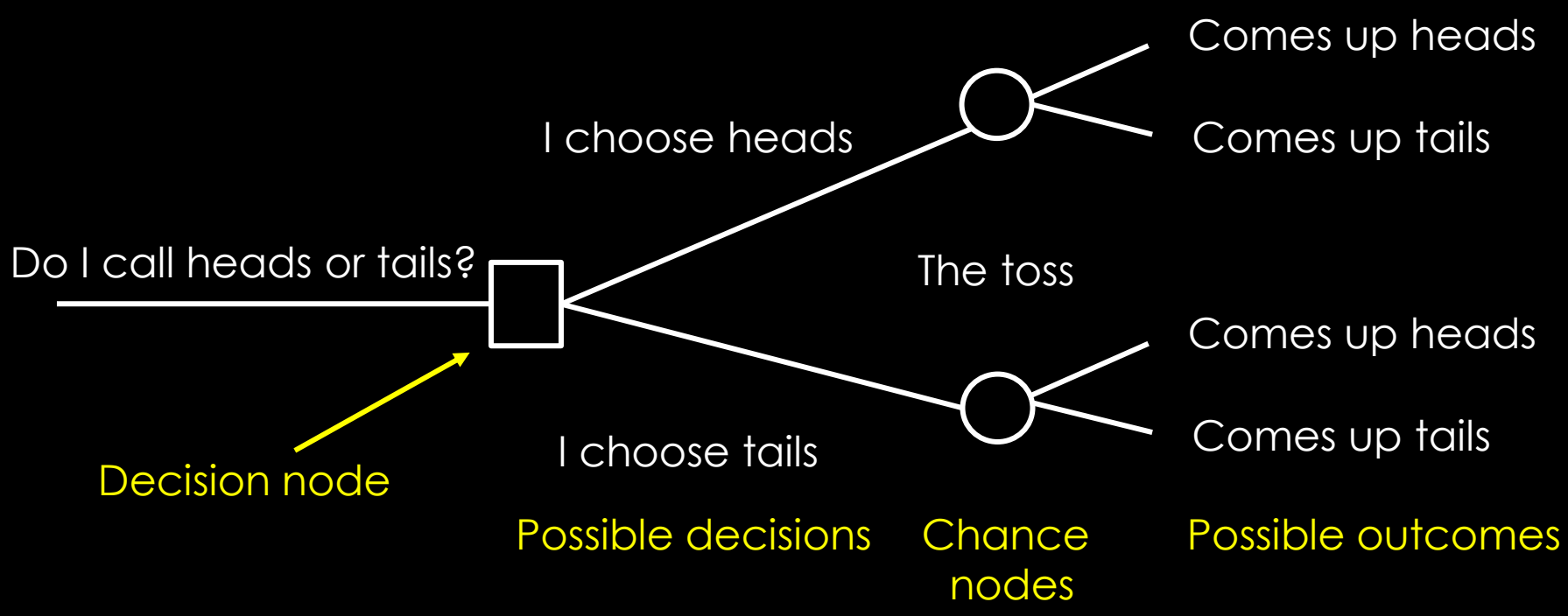
- Last week we showed how to make a decision between a number options with lots of considerations (tangibles and intangibles)
- Let us assume the decision was pursuing a career of being a Dental Hygienist. Now we can go back to the original problem statement that started this and revise it. This might be a revised statement:

  "What affordable local 2 yr. community or technical college, dental school or university should I go to become qualified to be a Dental Hygienist."

- As you can see, we incorporated the decision we made last week as the goal in the original problem statement. It could also be view as a boundary as we are not looking at other career options with this problem statement, only places to become qualified to become a Dental Hygienist. This significantly narrows the analysis for what school to attend.

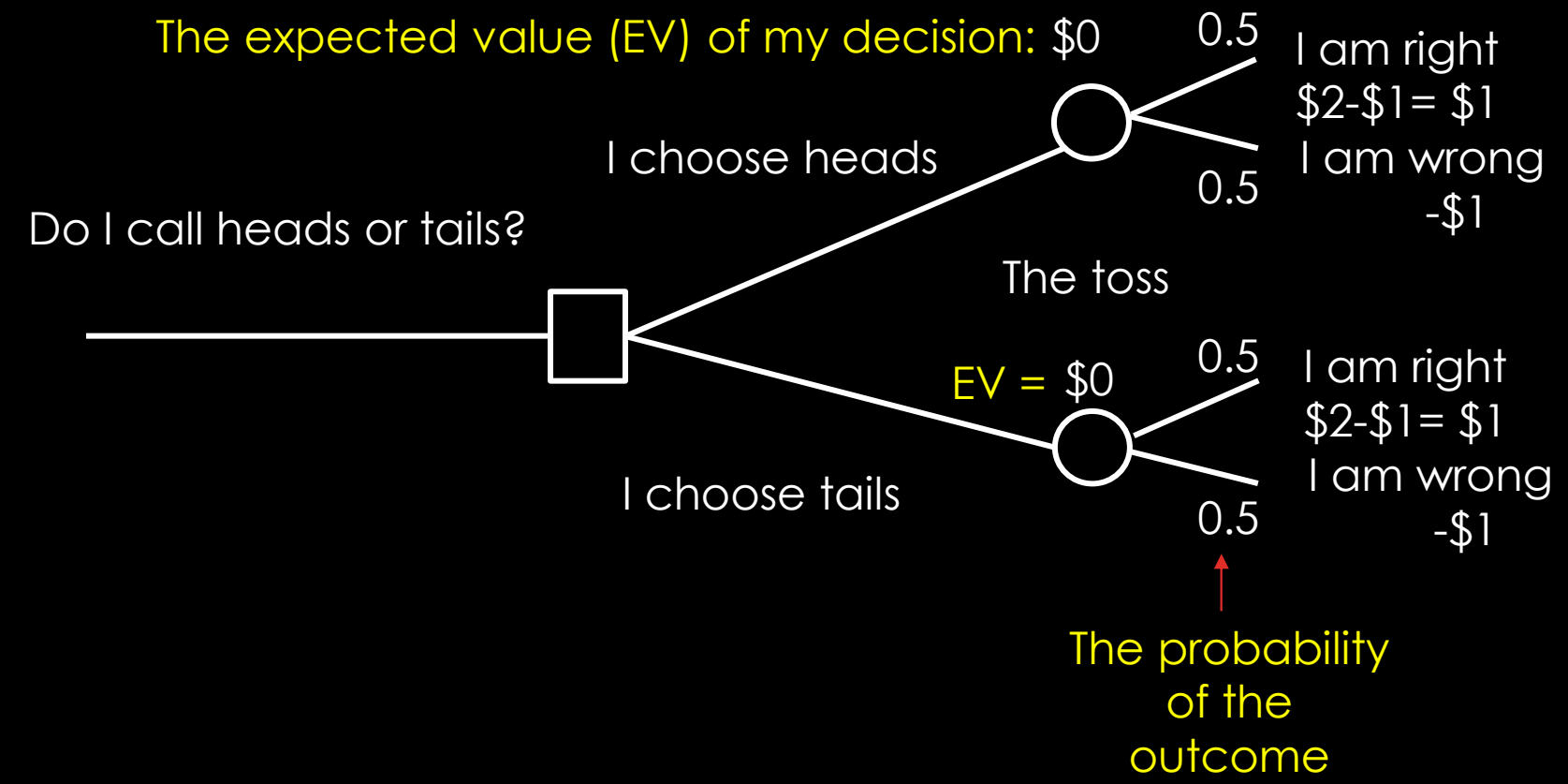
DECISION TREES AND UNCERTAINTY

- Decision trees are tools to graphically show decisions & possible outcomes
- The more complex the decision or possible outcomes, the more valuable this tool becomes
- Let's start with a very simple example - heads or tails coin toss ☺



DECISION TREES AND UNCERTAINTY

Assume you are paying $1 and the payoff is $2



CHANCE NODE FOR EXERCISE 1 (WEEK 1)

Recall the original lottery cost $1 to win $2 if the side of the 6-sided die you picked came up

EV = 0.167*$1-0.833*$1 = -$0.67

0.167 I am right $2-$1= $1

I am wrong -$1

0.833

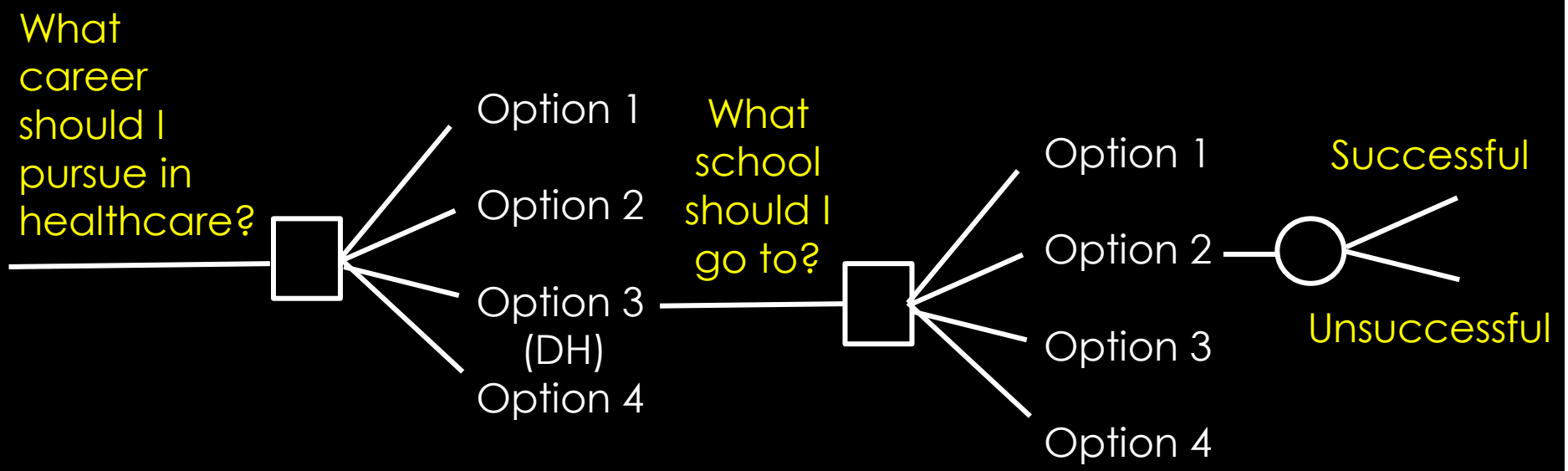
The probability of the outcome

DECISION TREES

For complex problems decision trees can have multiple decision and chance nodes and sometimes chance nodes that occur between or before decision nodes. Examples of these include:

- You need to make a quick decision based on what may happen at a future event
- You have a problem and decide to prototype or conduct an experiment and based on how that turns out you may need to make adjustments and decide on what to do next. If the cost and/or time to prototype or run an experiment is high, you may want to create a decision tree first to understand if that is the path you really want to take or not even start down the path. ☺

ABBREVIATED DECISION TREE EXAMPLE OF OUR CAREER AND SCHOOL CHOICE PROBLEMS



Note: Successful / Unsuccessful grossly simplifies the possible outcomes. There are many possible outcomes. Typically, we focus on the most likely ones and group low probably outcomes together unless the outcome is significantly bad or good.

DECISION SCIENCE

Week 6 - Summary and Exercise