Module 16 Practice Problems

1) **Is Bill Belichick a MadMan!!**

INDIANAPOLIS(AP) - Bill Belichick risked everything on one play Sunday night. After the New England coach failed on a stunning gamble deep in his own territory, Payton Manning threw a 1-yard touchdown pass to Reggie Wayne with 13 seconds left that rallied the unbeaten Colts to a 35-34 win over the Patriots.

Needing a first down to seal the game, Belichick decided to go for it on fourth-and-2 from his own 28 with 2:08 to go instead of punting. Kevin Faulk made a juggling catch but was tackled a half-yard short of the first-down.

"We tried to win the game on that play," Belichick explained. "I thought we could make the yard. We had a good play, we completed it. I don't know how we couldn't get a yard."

The Patriots didn't dare second-guess their coach, though everybody else did.

"That fourth-down play, that's one of your best plays, and you go to one of your best guys," Brady said. "We've got our offense on the field. We have over 450 yards of offense at the time. We've got a lot of great players on our offense. They stopped us."

The miss gave Manning 1 minute, 57 seconds and all three timeouts - an eternity for the three-time MVP - and he went right to work.

Assume the following: The Patriots had a 80% chance of successfully getting the first down on the 4^{th} and 2 play. If they made the first down, assume the Colts had a small (say 10%) chance of getting the ball back and scoring a touchdown in subsequent action to win the game. If they didn't make the first down , assume the Colts (consistent with NFL data) had an 80% of scoring a touchdown to win the game.

Now, if the Patriots would have punted the ball (which would be conventional coaching wisdom), the Colts would have likely had the ball 70 yards away from the end zone. NFL data indicates that they would have had a 30% chance of scoring the game winning touchdown from there.

From the Patriots perspective, using an 'expected value' criterion, was Coach Belichek's decision the wrong one?

2) **The Perfect Storm**

You are planning a social event that involves the outdoors. Of course, living in Oklahoma, you must deal with unpredictable weather. You have heard of specialized companies that forecast

weather with (allegedly) more accuracy than the national weather service. They of course charge for such a service (say cost = unknown X).

The weather for your social event can be classified as two states – Sunny and rainy.

The National Weather Service predicts a 60% chance of Sun and a 40% chance of rain for the specific day that you are considering. If you choose not to go with a specialized weather prediction company, then you will have your event in a generic way that provides you with $200 monetary payoff if it is sunny, $150 monetary payoff if it rains.

Suppose you are considering using the Storm Company to forecast the weather for your event. You know from historical data that when they forecast "Good" weather, 70% of the time it is sunny, 30% rainy. Likewise, when they forecast "Bad" weather, 80% of the time it is rainy, the other 20% it is sunny.

The payoffs for two different plans, Plan X and Plan Y – vary based upon whether it is sunny or rainy AND whether or not Company Storm predicts bad or good weather (perhaps a stretch here). The table below shows the eight different combinations.

Predict	**Plan**	**Sun/Rain**	**Payoff**
Good	Plan X	Sun	300
Good	Plan X	Rain	150
Good	Plan Y	Sun	400
Good	Plan Y	Rain	0
Bad	Plan X	Sun	250
Bad	Plan X	Rain	240
Bad	Plan Y	Sun	0
Bad	Plan Y	Rain	300

For this coming event, there's an 80% likelihood that should the Storm Company be consulted, they will predict Good weather for the event.

a) At what cost should the Storm Company be used?
b) What plan should be selected if the Storm Company is used? Does it depend upon the prediction of Good or Bad weather?

3) PLAY BALL!!

The St. Louis Cardinals are preparing to face the Chicago Cubs on an important two-game weekend series in St. Louis. Both teams have three pitchers who are available to pitch in the two games.

For the first game, Chicago's manager Leo Durocher has already announced that Ken Holtzman will start. St. Louis' manager Red Schoendienst has two choices for game 1, Bob Gibson and

Steve Carlton. His other pitcher, Nelson Briles, is available only for the second game (along with whoever did not pitch in Game1).

The following table represents the probability that the Cardinals will win a game given the specific pitcher match-ups (e.g., if Gibson pitches against Jenkins, the Cardinals will win 60% (3/5) of the time).

	F. Jenkins	K. Holtzman	B. Hands
B. Gibson	3/5	1/2	5/8
S. Carlton	2/5	1/2	1/4
N. Briles	3/5	2/5	1/2

Also note that because of their different competitive mentalities, these probabilities of Cardinal victories are different for Gibson and Carlton depending upon whether or not the previous game in the series was a win or loss. Gibson pitches better after his team loses: add .2 to the probability of him winning against all pitchers if the Cardinals lost the prior game, while subtract .05 from the probability of a Cardinal victory if the Cardinals won the prior game against the Cubs.

Conversely, Carlton's chances of winning increase by .1 after a Cardinals win, but decrease by .1 after a Cardinals loss. Briles chances of winning, and the Cubs' pitchers, are not affected.

Other notes: Don’t worry about what happened in the last game played before this series (in terms of wins and losses). AND A PITCHER CAN ONLY PITCH IN AT MOST ONE GAME IN THE SERIES.

The sequential decisions in this model are therefore:

0) CUBS – Named Holtzman as their pitcher – no decision branch necessary
1) CARDS – Choose between Gibson and Carlton to start Game 1.
2) CUBS – Choose between Jenkins and Hands to start Game 2.
3) CARDS – Choose between Briles and whoever was not selected in Game 1 for Game 2.

Create a decision tree that will determine the following information:

1) Who should the Cardinals pitch in Game 1, given that both Durocher and Schoendienst make their pitching decisions based on maximizing their own respective expected number of wins?
2) After Game 1 is over, the Cubs must first name their pitcher for Game 2. Who will they name under what conditions? Be careful, this choice may have contingencies.
3) After the Cubs name their pitcher for Game 2, who will the Cardinals choose for their starting pitcher and under what conditions?
4) What is the expected number of wins for the Cardinals during this 2 game series.

4) HOTSUIT PUB GAME

Consider the following game.

Equipment: Regular playing card deck – 52 cards consisting of 4 'suits', each suit 13 cards. Suits are Hearts, Diamonds, Clubs and Spades.

Rules: Costs $1 for player to enter.

Step 1: Player declares the 'HotSuit' (either Hearts, Diamonds, Clubs and Spades)

Step 2: Player blindly draws a card from the deck and sets it aside face up.

Step 3: If card drawn matches the 'HotSuit' then player must choose either

- D1: Accept $3 in winnings, and the game ends.
- D2: Draw again from the remaining 51 cards.

If draw again, then the player draws another card (blindly). If it too matches the "HotSuit", then the player wins ***$12*** and the game ends. If it doesn't match the "HotSuit", then the player wins nothing and the game ends.

Step 4: If card drawn does not match the 'HotSuit' then player must choose either

- D1: Accept your fate (no winnings), and the game ends.
- D2: Wager another $1, then draw again from the remaining 51 cards.

If draw again, then the player draws another card (blindly). If it matches the "HotSuit", then the player wins $6 and the game ends. If it doesn't match the "HotSuit", then the player loses again and the game ends.

Questions:

A) From the player's perspective, what is the expected value of playing the game?
B) When answering A), discuss the optimal decisions the player would choose if playing the game.
C) Would anything change if the ***$12*** payoff in Step 3 was increased to ***$17***? Show and explain.

5) "US" vs. "THEM"

The following describes a hypothetical yet representative new product promotion decision.

Your firm's ("US") market research department has identified an untapped market for a new product that only you and one competitor ("THEM") can offer. There is a 40% likelihood that the present value of future cash flows of this untapped market is $300,000, a 30% likelihood of P.V. of F.C.F. is $250,000 and a 30% likelihood of P.V. of F.C.F. is $200,000 (expected value of $255,000 – I saved you the calculation).

For "US", the estimated R & D cost for developing the new product is $70,000. Expenses for a major advertising campaign to accompany the product's introduction are $50,000, $25,000 for a minor advertising campaign. An advertising campaign must accompany the product introduction.

It is likely that "THEM" will try to develop a similar product for the same market niche IF AND ONLY IF "US" actually undertakes the product development and advertising campaign. Since they would be playing 'catch-up', it is estimated from past experiences in dealing with this competitor (and corporate espionage findings) that "THEM"'s cost to develop the new product would be $80,000, their cost for the necessary advertising campaign to accompany the product's introduction would be $55,000 for a major campaign and $28,000 for a minor campaign.

Previous experience in "US" vs. "THEM" competition has lead to the following table which estimates the percentage of market share that "US" would receive given the different combinations of product introduction decisions. For instance, if "US" introduces the product with a major advertising campaign and "THEM" counters with a minor advertising campaign associated with its new product, then "US" would anticipate capturing 70% of the market share, with "THEM" capturing 1.0-0.7=30%.

	"THEM" Response		
	Major	Minor	None
Major - US	60%	70%	100%
Minor - US	40%	50%	100%
None - US	n/a	n/a	n/a

Determine what the optimal strategy should be for "US" with regard to the three decisions facing them: Do nothing, introduce the new product with a major advertising campaign, or introduce the new product with a minor advertising campaign. What should "THEM" do? Be careful in measuring payoffs and costs of the different alternatives.

6) **What to Do, What to Do?**

A company has three products it is considering introducing. It will choose only one of (A,B,C). The measure of the products success is in NPV.

Product A is risk-free – it will earn $1 million NPV regardless of anything. (Yet another Jon Cusack reference!).

Product B is more risky. Sales can be high, medium or low. High sales = return of 8 million NPV, medium sales = return of 3 million, and low sales a return of 0.5 million. The likelihood of each event is assessed as 40% high sales, 15% medium sales and 45 % low sales.

Product C has even more risk. There is a small chance (5%) that the introduction of the product will be delayed due to some engineering issues. A delay will impact sales and return.

A price decision for Product C also has to be made – high price or low price. This price decision will be made AFTER we know if there has been a delay or not, but right before product introduction. Sales for Product C can be either High or Low.

With setting a low price, High sales and Low sales are equally likely, regardless of a delay or not.

With setting a high price, and there was no delay, High sales will be 40% likely. With a delay, high sales will only be 25% likely.

The table below shows the expected return (NPV) in millions given price/delay-no delay/sales.

			High Sales	Low Sales	
	Time Delay	High Price	6.0	-1.0	
		Low Price	3.5	0.5	
	No Delay	High price	10.0	0	
		Low Price	4.0	2.0	

a) Create a decision tree that models the issues in deciding between Products A, B and C.

b) Describe what the expected profit criteria suggests the decision(s) that should be made.

c) Given the answer in B), what percentage of the time to we expect to make a profit (NPV greater than 0)? Compare all 3 products on this dimension. If we used different criteria than expected value, would our best choice be different?

7) YOU MAKE THE CALL!!

BACKGROUND:

American football is a rather peculiar looking game, where players on a team try to run and pass an oblong ball made of pigskin across a goal line to score a *touchdown*! The object of the game is to score more points than the opposing team.

Touchdowns are worth 6 points to a team. After each touchdown, a team has an option to try a one point extra point by kicking the football between the goalposts or to attempt an extra point worth two points by trying to run or pass the ball across the goal line from 3 yards away. Kicking the extra point is a fairly certain occurrence (assume 95% success rate), while trying to score a two-point extra point is much more uncertain (assume a 40% success rate).

In light of this, consider the following problem based upon one of the most talked about college football bowl games EVER played (yes, even now almost 30 years later):

DATE & TIME: 1/2/84, almost 12:00 a.m. EST
PLACE: Miami, FL, in the old, rat-infested Orange Bowl.
WHAT: 1984 Orange Bowl Football Game between #1 ranked and undefeated University of Nebraska and #5 ranked (and once-beaten) Miami University.
SITUATION:

Mid-way through the fourth quarter (just under 7 minutes to go in the game), Nebraska has just scored a touchdown to make the score 31-23 in favor of Miami. Thus, they are faced with a choice of either running or passing for a two point "extra point" or attempting the more reliable one point kick.

At this point of the game, the most optimistic outcome that Coach Dr. Tom Osborne can count on is Miami going scoreless the remainder of the game, with Nebraska scoring once more, putting them in position to win (or tie) the game. Note that there were no provisions for overtime in 1984. It could be assumed that a tie will allow Nebraska to remain the #1 ranked team, as both the #2 and #3 ranked teams have lost in their bowl games played earlier in the day. Obviously, a win will keep Nebraska undefeated and #1.

Assuming that the aforementioned most optimistic outcome will occur, what decision(s) should Coach Osborne make regarding the extra points (1-pt or 2-pt) after the present touchdown and after the next touchdown (assuming it occurs) if we view winning the game as twice as desirable as a tie, and both outcomes infinitely more desirable than losing? What is the likelihood of Nebraska winning? Tying? Winning the national title?

HISTORICAL NOTE: Coach Osborne opted to go for the 1-point extra point after the first touchdown (it was successful, making the score 31-24) and then went for a two-point extra point after the second touchdown with 48 seconds left in the game (it failed, making the score 31-30, which is how the game ended).

MORE QUESTIONS: What was his assessment of the desirability of a tie? Who was Miami's coach? Why was Miami named #1 after the game, instead of previously fourth ranked Auburn, who won their bowl game?

EVEN MORE: Can you find other historical situations where coaches choose the same or different options?