Chapter 2 TASK: Why the House Always Wins

Level 4 Sample Response

Our group was made up of 5 students, consisting of 4 game players and a dealer. We played 2 rounds of each of the games "Pick the Suit," "Pick the Value," and "Pick the Card,". The results were as follows:

Pick the Suit

C = Club, S = Spade, D = Diamond, H = Heart

Player No.	Player's Prediction	Wager	Dealer's Result	Win /Loss	Remaining Chips
1	C	3 chips	S	-3 chips	17
2	H	2 chips	H	+4 chips	24
3	D	3 chips	C	-3 chips	17
4	D	3 chips	D	+6 chips	26
1	D	4 chips	H	-4 chips	13
2	S	3 chips	H	-3 chips	21
3	S	4 chips	C	-4 chips	13
4	S	4 chips	D	-4 chips	22

Pick the Value

Player No.	Player's Prediction	Wager	Dealer's Result	Win /Loss	Remaining Chips
1	7	2 chips	5	-2 chips	13 – 2 =11
2	9	6 chips	Queen	-6 chips	21 – 6 = 15
3	King	3 chips	10	-3 chips	13 – 3 = 10
4	Ace	5 chips	Jack	-5 chips	22 – 5 = 17
1	8	4 chips	King	-4 chips	7
2	King	5 chips	7	-5 chips	10
3	4	5 chips	9	-5 chips	5
4	8	4 chips	Queen	-4 chips	13

Pick the Card

C = Club, S = Spade, D = Diamond, H = Heart

Player No.	Player's Prediction	Wager	Dealer's Result	Win /Loss	Remaining Chips
1	8C	3 chips	Ace S	-3 chips	7 – 3 = 4
2	3D	3 chips	2S	-3 chips	10 – 3 = 7
3	7S	3 chips	8D	-3 chips	5 – 3 = 2
4	Ace D	3 chips	3C	-3 chips	13 – 3 = 10
1	6H	4 chips	4C	-4 chips	0
2	5S	3 chips	9S	-3 chips	4
3	7D	2 chips	6S	-2 chips	0
4	7D	6 chips	7C	-6 chips	4

1. After the first two rounds of Pick the Suit, 2 players (50%) had increased and two (50%) had decreased. After the two rounds of Pick the Value, all (100%) had decreased their totals.
After playing Pick the Card, all of the players (100%) continued to have fewer than 20 chips and two had lost all of their chips.

2. Our 4 players had 8 chips remaining out of 80, so we have lost 72 chips. This is

$\dfrac{72}{80} \times 100 = 90\%$.

3. In my group, as above, all 4 or 100% of the players decreased their number of chips.
In the second group (Pick the Suit) 2 players increased and 2 decreased.
In the third group (Pick the Card) 1 player increased and 3 decreased.
In the fourth group (Pick the Suit/Pick the Card) all 4 players decreased.
In the fifth group (Pick the Value/Pick the Card) 3 players decreased and one still had 20 chips.

Therefore 2 players out of 20 increased their number of chips, which is $\dfrac{2}{20} \times 100 = 10\%$.

One player out of 20 still had 20 chips, which is 5%. 17 players out of 20 decreased their number

of chips, which is $\dfrac{17}{20} \times 100 = 85\%$.

4. My group had 8 chips remaining.
Group 2 had 76 chips remaining.
Group 3 players had 85 chips remaining.
Group 4 players had 56 chips remaining.
Group 5 players had 49 chips remaining.
Therefore the class decreased its number of chips by
$(20 \times 20) - (8 + 76 + 85 + 56 + 49) = (400 - 274)$ or 126 chips.

This is a decrease of $\dfrac{126}{400} \times 100 = 31.5\%$.

5. a) I expected that the class would lose more chips than they did. My group lost almost all of our chips, but group 2 which played Pick the Suit kept most of their chips because in that game they have a 1 in 4 chance of winning. I think that the results for our class were higher than I expected, because one player in group 3 won 100 chips in Pick the Card, a game where a player has only a 1 in 52 chance of winning. The groups that played the Pick the Value or Pick a Card for all or part of the time had a very small chance of winning chips.

b) The rewards for winning the 3 games are 2 to 1, 5 to 1 and 10 to 1 respectively.

c) The corresponding theoretical probabilities are 25% (4 to 1), 7.69% (13 to 1) and 1.92% (52 to 1). The game would be fairer if the rewards matched the probabilities. The "house always wins" because the probabilities are always in the dealer's favour. In Pick the Suit the dealer's probability of winning is 3 out of 4 or 75%; in Pick the Value the dealer's probability of winning is 12 out of 13 or 92.31%; in Pick the Card the dealer's probability of winning is 51 out of 52 or 98.08%.

6. Organizers will want a few players to win, especially in Pick the Value and Pick the Card, in order to make players feel that it is possible to win larger numbers of chips. This will encourage them, and others, to play the games. However, the theoretical probabilities show that they are very likely to lose badly.

Level 4 Notes:

Look for the following:
- Insightful understanding of the card games
- Thorough organization of the data and accurate calculation of percents
- Thorough understanding of theoretical probability
- Highly effective application of a problem solving strategy to analyse the data
- Highly organized and clearly justified responses
- Highly effective use of mathematical language

Chapter 2 TASK: Why the House Always Wins

Level 3 Sample Response

My group of 5 students (dealer and 4 players) played 4 rounds of the game "Pick the Value" with the following results.

Pick the Value

Player	Prediction	Wager	Result	Win /Loss	Remaining Chips
A	6	2 chips	Ace	–2 chips	18
B	10	7 chips	7	–7 chips	13
C	6	2 chips	8	–2 chips	18
D	King	7 chips	Jack	–7 chips	13
A	5	10 chips	King	–10 chips	8
B	7	7 chips	King	–7 chips	6
C	3	7 chips	Jack	–7 chips	11
D	5	8 chips	6	–8 chips	5
A	3	4 chips	Queen	–4 chips	4
B	8	1 chips	4	–1 chips	5
C	Ace	7 chips	Queen	–7 chips	4
D	Queen	5 chips	Queen	25 chips	30
A	8	4 chips	Ace	–4 chips	0
B	10	5 chips	5	–5 chips	0
C	5	4 chips	9	–4 chips	0
D	7	10 chips	2	–10 chips	20

1. Player A has 0 chips; Player B has 0 chips; Player C has 0 chips; Player D has 20 chips.
75% of the players lost chips; 0% of the players won chips; 25% of the players still have 20 chips.

2. The 4 players have 20 chips remaining out of 80—a decrease of 60 or 75%.

3. There were 5 groups in the class.
In my group (Pick the Value) 3 players decreased and 1 stayed the same.
In the second group (Pick the Suit) 2 players increased and 2 decreased.
In the third group (Pick the Card) 1 player increased and 3 decreased.
In the fourth group (Pick the Suit/Pick the Card) all 4 players decreased.
In the fifth group (Pick the Value/Pick the Card) 3 players decreased and one still had 20 chips.

Therefore 3 players out of 20 increased their number of chips which is $(3 \div 20) \times 100 = 15\%$.
One player out of 20 still had 20 chips which is 5%, and 16 players out of 20 decreased their number of chips, which is $(16 \div 20) \times 100 = 75\%$.

4. Group 1 players had 20 chips remaining.
Group 2 players had 81 chips remaining.
Group 3 players had 43 chips remaining.
Group 4 players had 13 chips remaining.
Group 5 players had 29 chips remaining.
Therefore the class decreased its number of chips by $(20 \times 20) - (20 + 81 + 43 + 13 + 29)$
$= (400 - 186) = 214$ chips OR a decrease of $(214 \div 400) \times 100 = 53.5\%$.

5. a) I expected that the class would lose chips. Those groups that played the game Pick a Card for all or part of the time had a very small chance of winning chips.
b) The theoretical probability of winning Pick the Suit is 1 out of 4 or 25%.
The theoretical probability of winning Pick the Value is 1 out of 13 or 7.7%.
The theoretical probability of winning Pick the Card is 1 out of 52 or 1.9%.
c) The reward for winning Pick the Suit is 2 chips for 1 chip and the theoretical probability of winning is 25%. The reward for winning Pick the Value is 5 chips for 1 chip and the theoretical probability of winning is 7.7%. The reward for winning Pick the Card is 10 chips for 1 chip and the theoretical probability of winning is 1.9 %.
The rewards do not seem to be appropriate especially for Pick the Value and Pick the Card, because the chances of the player winning are really low, while the theoretical probability that the dealer wins is high. I think that all the rewards should be higher, Pick the Suit - 4 chips to 1, Pick the Value - 13 chips to 1 and Pick the Card - 52 chips to 1.

6. If nobody wins in all three games, all the players will lose interest and nobody will want to play.

Level 3 Notes:

Look for the following:
- Understanding of the card games
- Appropriate organization of the data and accurate calculation of percents
- Understanding of theoretical probability
- Application of an appropriate problem solving strategy to analyse the data
- Organized and justified responses
- Effective use of mathematical language

Chapter 2 TASK: Why the House Always Wins

Level 2 Sample Response

My group played the game "Pick the Suit" for 4 rounds. We had 4 players and a dealer.

Pick the Suit

H is Hearts, S is Spades, C is Clubs, and D is Diamonds

Player	Prediction	Wager	Turned Card	Win /Loss
1	S	2 chips	S	Won 4 chips
2	C	3 chips	D	Lost 3 chips
3	D	4 chips	S	Lost 4 chips
4	S	6 chips	S	Won 12 chips
1	C	3 chips	C	Won 6 chips
2	C	1 chips	S	Lost 1 chips
3	S	2 chips	C	Lost 2 chips
4	S	4 chips	D	Lost 4 chips
1	C	7 chips	S	Lost 7 chips
2	C	9 chips	C	Won 18 chips
3	H	8 chips	S	Lost 8 chips
4	H	10 chips	S	Lost 10 chips
1	S	7 chips	C	Lost 7 chips
2	H	8 chips	D	Lost 8 chips
3	C	6 chips	H	Lost 6 chips
4	D	7 chips	C	Lost 7 chips

1. Player 1 has (20 + 4 + 6 – 7 – 7) = 16 chips

Player 2 has (20 – 3 – 1 + 18 – 8) = 26 chips

Player 3 has (20 – 4 – 2 – 8 – 6) = 0 chips (Player 3 ran out of chips in Round 4)

Player 4 has (20 + 12 – 4 – 10 – 7) = 11 chips.

One player out of 4 increased the number of chips – this is 25%.

Three players lost chips – this is 75%.

No player still had 20 chips.

2. The 4 players now have (16 + 26 + 0 + 11) = 53 chips. This is a loss of (80 – 53) = 27 chips.
The loss is (27 ÷ 80) × 100 = 33.75%.

3. There are 5 groups in the class. In the other 4 groups 3 of the players had more than 20 chips and 13 had fewer than 20 chips. Therefore 4 players out of 20 went up, which is 25% and 16 out of 20 went down, which is 75%. (*arithmetical errors*)

4. My group had 53 chips. The second group played "Pick the Value" for 4 rounds and they had 43 chips left. The third group played "Pick the Card" and had 133 chips left. The fourth group played 2 rounds of "Pick the Suit" and two rounds of "Pick the Value" and had 29 chips left. The fifth group played "Pick the Card" and had 18 chips left

So the class had $(53 + 43 + 133 + 29 + 18) = 276$ chips left out of $20 \times 20 = 400$.

This is a decrease of $(276 \div 400) \times 100 = 69\%$. (Error: *Should be $(124 \div 400) \times 100 = 31\%$*)

5. a) I was surprised that the class lost such a large percentage of chips. I expected them to have about the same number of chips as they started with.

b) The theoretical probability of winning "Pick the Suit" is 1 out of 4 or 25%. The theoretical probability of winning "Pick the Value" is 1 out of 13 or 7%. *(Should be 7.69% or 8% rounded off).* The theoretical probability of winning "Pick the Card" is 1 out of 52 or 2%. (*Should be 1.92%)*

c) The reward for winning "Pick the Suit" is 2 chips for 1. The theoretical probability is 25%. It seems that the reward is too small. I think it should be larger, like 4 chips for 1.

The reward for winning "Pick the Value" is 5 chips for 1. The theoretical probability is 7%. It seems that the reward is too small. I think it should be larger, like 10 chips for 1.

The reward for winning "Pick the Card" is 10 chips for 1. The theoretical probability is 2%. It seems that the reward is too small. I think it should be larger, like 25 chips for 1.

6. I think that the organizers may want a few players to win so that some more people will be interested in playing the game.

Level 2 Notes:

Look for the following:

- Incomplete understanding of the card games and playing strategy
- Some organization of the data and some correct calculations of percents
- Some understanding of theoretical probability
- Some effectiveness in applying an appropriate problem solving strategy to analyse the data
- Some organization and justification in responses
- Some effectiveness in using mathematical language

Chapter 2 TASK: Why the House Always Wins

Level 1 Sample Response

My group played the game Pick the suit for 4 rounds.

1. Jim had 15 chips left.

Manny had 22 chips left.

Maria had 10 chips left.

Dom had –4 chips left. (*Error)*

One player out of 4 increased his number of chips – this is 0.25 (*Error)*

Three players lost chips – this is 0.75. (*Error)*

No player still had 20 chips.

2. The 4 players have 15 + 22 + 10 + (-4) = 51 chips left. This is a loss of 29 chips.

The loss is (29 ÷ 51) × 100 = 56.86%. (*Error)*

3. There are 5 groups in the class. In the class 5 of the players had more than 20 chips left and 11 had fewer than 20 chips left. Therefore 5 players out of 20 went up, which is 0.2 and 11 out of 20 went down, which is 0.8. (*Errors)*

4. My group had 51 chips left. The second group had 145 chips left. The third group had 37 chips left. The fourth group had 34 chips left. The fifth group had 25 chips left

So the class had (51 + 145 + 37 + 34 + 25) = 294 chips left out of 400.

The class went down by106 chips.

5. a) I thought that the class that the class would win. I expected them to have more chips than they started with, just like when people win the lottery.

b) The theoretical probability of winning Pick the suit is 1 out of 2. The theoretical probability of winning Pick the value is 1 out of 5. The theoretical probability of winning Pick the card is 1 out of 10. (*Error)*

c) The reward for winning at Pick the suit is 2 chips for 1 or 200%. The reward for winning at Pick the value is 5 chips for 1 or 500%. The reward for winning at Pick the card is 10 chips for 1 or 1000%. (*Error)*

6. I think that the organizers may want lots of players to win so that many more people will get excited about the game.

Level 1 Notes:

Look for the following:
- A simple understanding of the card games
- A little organization of the data and calculation of percents
- A little understanding of theoretical probability
- A little understanding of problem solving strategy but has great difficulty in applying techniques to analyse the data
- Poorly organized and justified responses
- Little use of mathematical language