

Homework 14: Poker with 5 suits (Due 10am 5/9/08)

Between 1-3 persons can submit the same worksheet. By signing your name you agree that you have met with the team and contributed constructively to solving every problem.

Staple separate paper with combinatorial justification for each probability. Work that is not easily readable will receive no credit.

Team Member 1 _____

Team Member 2 _____

Team Member 3 _____

For this worksheet, assume a deck of cards has 13 ranks and **5 suits** ($13 \times 5 = 65$ total cards). As a set the deck is $\{A, 2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K\} \times \{C, D, H, S, B\}$ (The new suit is B = Bells.)

In the game 5-card hands are still dealt. Now a new type of hand is possible – a **rainbow** hand. A rainbow hand is a 5-card hand in which there is one card from each suit (one club, one diamond, one heart, one spade, and one bell). Various types of hands are defined below. Compute the probability of getting each *type* of hand, assuming that each hand is equally likely. Tabulate these probabilities in the table, both in terms of combinatorial coefficients, and as decimal approximations to 3 places. Give the “winning order” of the hands by ordering them from lowest probability to highest probability. (Best hand = Royal Rainbow or Royal Flush?)

Definitions of hand types

Royal Rainbow 10, J, Q, K, A with all distinct suits

Royal Flush 10, J, Q, K, A all of same suit

Straight Rainbow All consecutive ranks and all distinct suits, but not a Royal Rainbow. A, 2, 3, 4, 5 and 9, 10, J, Q, K are considered to be in consecutive rank order.

Straight Flush All consecutive ranks and all the same suit, but not a Royal Flush. A, 2, 3, 4, 5 all of the same suit is a straight flush.

Straight All consecutive ranks but not a royal rainbow, royal flush, straight rainbow, or straight flush. A, 2, 3, 4, 5 is a straight.

Flush All cards of same suit, but not a royal flush or straight flush.

Rainbow 4 of a Kind 4 cards of the same rank, and all 5 suits are present.

4 of a Kind 4 cards of the same rank, but not rainbow.

Rainbow Full House 3 cards of one rank and 2 cards of a second rank, and all 5 suits present.

Full House 3 cards of one rank and 2 cards of a second rank, but not rainbow

Rainbow 3 of a Kind 3 cards of one rank, and all 5 suits present, but not a rainbow 4 of a kind or rainbow full house.

3 of a Kind 3 cards of one rank, but not 4 of a kind or a full house, and not rainbow.

Rainbow 2 Pair Two cards of one rank and Two cards of a second rank, and all 5 suits present, but not a rainbow full house.

2 Pair Two cards of one rank and Two cards of a second rank, but not a full house and not rainbow.

Rainbow Pair 2 cards of one rank and all 5 suits present, but not a rainbow 4 of a kind, full house, 3 of a kind, or 2 pair.

1 Pair 2 cards of one rank but not rainbow, 4 of a kind, full house, 3 of a kind, or 2 pair.

Rainbow All cards have distinct suits, but not a royal rainbow, straight rainbow, rainbow 4 of a kind, rainbow full house, rainbow 3 of a kind, rainbow 2 pair, or rainbow pair

Hand Type	Probability	3-decimal approximation	Winning Order (1st-17th)
Royal Rainbow			
Royal Flush			
Straight Rainbow			
Straight Flush			
Straight			
Flush			
Rainbow 4 of a Kind			
4 of a Kind			
Rainbow Full House			
Full House			
Rainbow 3 of a Kind			
3 of a Kind			
Rainbow 2 Pair			
2 Pair			
Rainbow Pair			
1 Pair			
Rainbow			