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Classical Probability and Simulation Program Used In the "Qingdun"Poker Type Algorithm

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Abstract: *Qingdun is a kind of Poker game originated from Zhoushan city, Zhejiang province, It's a component of local distinctive culture[1].But some rules of the game is still incomplete. We see there is no references in the probability calculation about complex poker in most of literature. .In this paper, we mainly research probability of some card type. Theoretical method will be used to calculate the prior probability firstly, and then we use computer programs to simulate the game and statistics the posterior probability. Contrasting the prior probability and posterior probability and modifying some procedure until we obtain the precise probability of some card type. After that, his article will be a good reference for us to research in the field.*

Keywords:Qingdun , probability ,simulate , prior probability, posterior probability*

I. Introduction And Background

Qingdun is a poker game with distinctive features of Zhoushan,and the fishermen are far away from the land frequently ,so they invented the game to give up loneliness.According to the historical, we draw a conclusion that Qingdun started in Daishan county Zhoushan city,Zhejiang province about in eighty ages of last century ,and then They are popular in every district of Zhoushan about ninety century,and it becomes one of the most popular activities for entertaining in every agent.Qingdun poker is consist of three pairs of cards--every pair has 54 cards--.because its rules are relatively simple and the combination of cards is very flexible,so,these features cause the difficulties of algorithm and made it very complex to calculate the probability of every type of cards.Under the circumstances,we take the bomb--the number of cards with the same number of point is not less than four-- probability' s calculation for example,under the premise of not affecting the probability of relationship we need to simplify the model.But how to simplify the models of the calculation of probability? We take the cards from four players to one player to reduce the probability space,and the theoretical method will be used to calculate the prior probability firstly, then we use computer programs to simulate the game and statistic the posterior probability.According to contrasting the prior probability with posterior probability ,and then modifying some procedure until we obtain the precise probability of some card types.

II. The Theoretical Calculation

We need to confirm one question before the theoretical calculation.In order to simplify models, we take the cards from four players to one player to reduce the probability space for calculating probability.Is this idea correct? If you are careful, you will find that the key point of contention is the question of the order of getting the card,so if we can prove that there is no affect between one person to others by orders for getting the card,then what the question we given is correct. In order to simplify models,we assume there is only four kinds of cards called A,B,C,D,then in the process of a simulation,one player getting A cards is equivalent to other three players getting B,C and D cards.It is obvious that the probability of calculation is 1/4 -- $A_3^3 / A_4^4 = 1/4$ -- .There is no difference in calculating probability directly .it means there is no affect by orders for getting the card.

In the probability calculation of the specific card type,Qingdun poker is consist of three pairs of cards and the combination of cards is very flexible,so those features cause big difficulties to our calculation of probability.Such as Chen said we need to make the complex question to be simple by dividing[2].In order to overcome the difficulties,we need to simplify the card types by using the addition formula of probability to split models,and then make the most of the a variety of methods and knowledge of probability theory and its formula of deformation to get the theoretical calculation probability[3].

In order to express something conveniently,we define the event that cards A is bomb is B_1 ,and the event that cards 2 is bomb is B_2 and so on.According to probability addition formula,we can know the probability of the bomb in one player in one simulation of getting cards.the formula:

$$P = P\left(\bigcup_{i=1}^{13} B_i\right) = \sum_{i=1}^{13} P(B_i) - \sum_{1\le i<j\le 13} P(B_i B_j) + \cdots + P(B_1 B_2 \cdots B_{13})$$ [3].(*)

Because players get the different numbers of card-- two players get 40,and another two players get 41 --but here we mainly discuss the players who get 40,and the players who get 41 we can use the same method to get it .because the possibilities of B_i are too many to calculate ,so we discus the reverse side,and it also means that we get the number of card i is 0,1,2,or 3 .

$P(\overline{B_i}) = \sum_{i=0}^{3} \frac{C_{12}^{i} C_{150}^{40-i}}{C_{162}^{40}}$ so $\sum_{i=1}^{13} P(B_i) = C_{13}^{1} P(B_1) = C_{13}^{1}\left(1 - P(\bar{B}_1)\right)$,because B_i and B_j （$i \ne j$ ）is identically distribution , similarly

$$\sum_{1\le i<j\le 13} P(B_i B_j) = C_{13}^{2} P\left(B_1 B_2\right) = C_{13}^{2}(1 - 2P\left(\bar{B}_1\right) + P\left(\bar{B}_1\bar{B}_2\right)) ,$$

$$C_{13}^{3} P\left(B_1 B_2 B_3\right) = C_{13}^{3}(1 - 3P\left(\bar{B}_1\right) + 3P\left(\bar{B}_1\bar{B}_2\right) - P\left(\bar{B}_1\bar{B}_2\bar{B}_3\right)) ,$$

$\cdots$

$$C_{13}^{10} P\left(B_1 B_2 B_3 \cdots B_{10}\right) = C_{13}^{10}(1 - C_{10}^{1} P\left(\bar{B}_1\right) + C_{10}^{2} P\left(\bar{B}_1\bar{B}_2\right) - \cdots + P\left(\bar{B}_1\bar{B}_2\bar{B}_3 \cdots \bar{B}_{10}\right))$$

And wenoticed that $P(B_1 B_2 \cdots B_{11})$ and the later will not appear --the number of card is 40 totally -- according to (*),we get the formula:

$$P = \sum_{i=1}^{10}(-1)^{i+1} C_{13}^{i} + \sum_{i=1}^{10}(-1)^{i} C_i^{1} C_{13}^{i} P\left(\bar{B}_i\right) + \sum_{i=2}^{10}(-1)^{i+1} C_{13}^{i} C_i^{2} P\left(\bar{B}_1\bar{B}_2\right) +$$

$$\sum_{i=3}^{10}(-1)^{i} C_{13}^{i} C_i^{3} P\left(\bar{B}_1\bar{B}_2\bar{B}_3\right) + \cdots + \sum_{i=9}^{10}(-1)^{i} C_i^{9} C_{13}^{i} P\left(\bar{B}_1\bar{B}_2 \cdots \bar{B}_9\right) - C_{13}^{10} P\left(\bar{B}_1\bar{B}_2 \cdots \bar{B}_{10}\right) \quad (**)$$

So ,if we want to calculate P , we just need to calculate $P\left(\bar{B}_1\right)$, $P\left(\bar{B}_1\bar{B}_2\right), \cdots, P\left(\bar{B}_1\bar{B}_2 \cdots \bar{B}_{10}\right)$.

$$P\left(\bar{B}_1\right) = \sum_{i=0}^{3} \frac{C_{12}^{i} C_{138}^{40-i}}{C_{162}^{40}}, \quad P\left(\bar{B}_1\bar{B}_2\right) = \sum_{i=0}^{3}\sum_{j=0}^{3} \frac{C_{12}^{i} C_{12}^{j} C_{138}^{40-i-j}}{C_{162}^{40}}, \cdots$$

But the calculation is complex by hands,so we can use computers to resolve the problem. We just take the calculation of $P(\bar{B}_1\bar{B}_2\bar{B}_3)$ for example,the code is depended on C++ and behind of the section.

```
# include<stdio.h>

double com(int m,int n)// take the number of  n  from m

{
```

```
double i,j,sum=1;

for (i=m,j=0;j<n;j++,i--)

{
```

```
        sum=sum*i/(j+1);
    }
return sum;
}
int main()
{ double a,b,c,sum=0;
 for(a=0;a<=3;a++)
   {for(b=0;b<=3;b++)
      {     for(c=0;c<=3;c++)
              sum=sum+com(12,a)*com(12,b)*com(12,c)
*com(162-12*3,40-a-b-c)/com(162,40);
      }

   }
  printf("%20.15lf",sum);
  return 0;
}
```

Attention:There is limited to the space of article ,we can't take the code out totally,but in order to calculate it accurately,we need to use the (**) to calculate it at once.

According to (**),we get the answer finally, that is 0.999991748944871 . (1)

III. Computer Program Simulation

Next,we use computer program to simulate to check out our answer that we get it by the theoretical calculation[4].

```
#include <stdio.h>
#include <time.h>
#include <stdlib.h>
#include <string.h>
#define TOTALNUM 162
#define DECKOFCARDS 54

enum POKER_SUIT{
        CLUB,  //clubs
        DIAMOND, //diamonds
        HEART, //hearts
        SPADE, //spades
        BLACK_JOKER, //black joker
        RED_JOKER //red joker
};

struct Poker
{
        int point;
        POKER_SUIT suit;
};

//initialize a pair of cards
void InitOneDeckOfCards(Poker pokers[DECKOFCARDS])
{
        int size = 13; //13 pieces of each color
        int i;

        //put each suit in turn into a pair of cards
        for(i = 0; i < size; i++)
        {
                pokers[i].point = i+1;
```

```
            pokers[i].suit = CLUB;
        }

        for( ; i < 2 * size; i++)
        {
            pokers[i].point = i % size+1;
            pokers[i].suit = DIAMOND;
        }

        for( ; i < 3 * size; i++)
        {
            pokers[i].point = i % size + 1;
            pokers[i].suit = HEART;
        }

        for( ; i < 4 * size; i++)
        {
            pokers[i].point = i % size + 1;
            pokers[i].suit = SPADE;
        }

        //put the black joker and the red joker into a pair of cards of the last two
        pokers[52].point = 14;
        pokers[52].suit = BLACK_JOKER;
        pokers[53].point = 15;
        pokers[53].suit = RED_JOKER;
}

// upset 162 cards in order to simulate the process of shuffling random
void ShuffleCards(Poker pokers[TOTALNUM])
{
        //select one card from i to 162,then put it to the place of i
        for(int i = 0; i < TOTALNUM; i++)
        {
            int index = (rand() % (TOTALNUM - i)) + i;

            Poker p = pokers[index];
            pokers[index] = pokers[i];
            pokers[i] = p;
        }
}

//statistic the number  in the card whether there is a bomb,if yes then return 1 ,else 0
int HavaBomb(Poker pokers[], int n)
{
        int result[15] = {0}; //the number of cards for each point
        for(int i = 0; i < n; i++)
        {
            int point = pokers[i].point;
            result[point-1] += 1; //point is put the place of point-1

            if(result[point-1] >= 4)
                return 1;
        }

        return 0;
}

int main()
```

```
{
    Poker p54Cards[DECKOFCARDS];
    InitOneDeckOfCards(p54Cards);

    unsigned size = DECKOFCARDS *
sizeof(Poker);

    Poker p162Cards[TOTALNUM];

    memcpy(p162Cards, p54Cards, size);
    memcpy(&p162Cards[54], p54Cards, size);
    memcpy(&p162Cards[108], p54Cards, size);

    srand((unsigned)time(0));
    int t = 0, bomb = 0, totalTime = 1000000000;
    double Prob;
    while(t++ < totalTime)
    {
        ShuffleCards(p162Cards);
        if(HavaBomb(p162Cards, 40) == 1)
            bomb++;
    }
    Prob=bomb/totalTime;
    printf("The time of test: %d, the time of appear
bomb: %d\n", totalTime, bomb);
        printf("Prob=%20.15lf",Prob);
    getchar();
    return 0;
}
```

Operation result is 0.999991848000000 . (2)

Attention：the code is also suited for the calculation of other card types.

Summary

According to contrast (1) with (2),we find the probability error is about 0.0000001, so it meets our requirement. Of course,if you want to be more accurate,you can increase simulation times until you satisfy it.

On the other side,we find the probability of bomb that does not appear is really minimum,so it is precise that the appearance of the small probability event reflects the accuracy of our calculation results.

Firstly,we start with the theory,then we use the practice inspect the theory.It is a good idea for students to strengthen the ability of exercise[5]. Next , Qingdun poker is popular in Zhoushan,we can see the activities everywhere from time to time. Based on this background, this paper introduces the topic by combining the theoretical calculation of mathematics, computer program simulation with the cultural protection. This is one of the major features of this paper.Finally,we will go on to calculate other probability of different card types to get a correct regulation so that residents can play the activities without debating.

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