2016 IMMC Problem

Record Insurance

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Summary

Winners of the Zevenheuvelenloop will receive a substantial amount of bounty provided by the organizing committee, if they are able to break the world record. The committee, however, may choose to turn to the insurance company for support, where they can always exchange a significantly lower premium for the bonus. In order to offer the organizing committee a satisfactory solution to decide whether an insurance should be bought before any specific race is held, we have developed a model capable of finding applicable decision-scheme, which can be easily understood by the members of committee and implemented effectively.

In the first part of the model, we derived the reasonable premium for which the insurance company is expected to charge the organizing committee from a differential equation, including variables such as the interests earned when the premium is used for investment in the market, the operating cost and additional profit of the company (the last two variables are assumed to constitute 20% of the premium). A probability model in which a binomial distribution is applied lead us to the expected cost of the organizing committee if they decide to self-insure over n years (which purely depends on their own decision, although we have assumed it to be 10), then the result is compared with the premium. The comparison can decide whether a business deal between the organizing committee and the insurance company can be reached, i.e. only when the expected cost of self-insurance is higher than the total insurance cost, and lower than revenue made by the insurance company through investment in the markets. In the fourth question, we continued to use the probability model, where the probability of breaking world record is determined by an analogy with the historic data of former Olympic Games and the World Championships, and is assumed to stay as a constant as the competition precedes. Moreover, we provided an additional method of calculating the probability of setting a new world record in four throwing events, namely, the shot put, the javelin throws, the discus throw and the hammer throw. In this second model, environmental factors are also taken into account in four throwing sport events, including the air resistance, the direction in which the wind is blowing and its speed.

In the end, we have successfully developed a GUI where it is possible for the organizing committee to determine whether to buy insurance or self-insure by entering several inputs (including r, w, z, n, pm and pw) into the calculator, using the probability model that has been built earlier. After simulating using real world data, the calculator is proven to have a reliable and accurate performance.

Contents

1 Problem interpretation

1.1 Problem restatement

The organizing committee of Zevenheuvelenloop must choose wisely whether to buy any insurance from the relevant institution or to self-insure before each individual race is held, or they will bear the potential financial risk of giving away a considerable amount of bonus once a winner has broken the world record during his/her race. We hope to construct a corresponding mathematical model to come up with the optimal scheme.

1.2 Assumptions and justifications

1) The degree of difficulty, β, is assumed to be a constant.

2) During the whole period of time when it is possible to reach a business deal between the insurance company and the organizing committee, the inflation rate equals to zero.

3) The value of pm and pw remains constant over this period of time after they have been calculated using the historic data.

4) The number of years is always an integer.

5) The insurance company will invest in other fields using the money they received from the organizing committee to gain higher return.

6) The maximum possible number of times breaking the world record equals to the number of times holding the competition, meaning averagely no more than 1 time the record is broken in one competition.

1.3 Goal of modelling

The mathematical model that we have built is expected to:

1) Easily determine whether to buy insurance or self-insure by entering limited number of inputs

2) Be straightforward enough for members of the organizing committee to comprehend

3) Distinguish between circumstances under which a business deal can be reached between parties, and only one party will be benefited from either

buying an insurance or to selling the insurance.

In this model, we attempt to find a schedule that can excel in all these criteria.

1.4 Variable Table

VARIABLE	DEFINITION
y	total loan remained
x	time taken
z	operating cost per year
w	extra profit apart from time value of money per year
r	the coefficient of loan
k	money repaid each year to cover the loan apart from the operating cost and the profit needed
n	number of competitions the organizing committee plan to hold after 2016
Pm	the probability that the world record will not be broken by male athlete in any specific event
Pw	the probability that the world record will be not broken by female athlete in any specific event
B_d	degree of difficulty (assumed to be a constant), which doubles every 13.5≈14 years (for male athletes)
m	the number of 14-year-period passed from now on
A	average cost each year if the organizing committee decides to self-
R	rate of return of insurance company
C	the average insurance cost per year
α	the angle between the wind and the line that the discus initially
β_a	the angle between the line that discus goes in the air after release and the line that discus initially goes
θ	the angle between the line that discus initially goes and the horizontal line
ρ	density of air
A_a	cross-sectional area
h	elevation of ground above mean sea-level
P_0	standard atmosphere pressure
t	the time it takes from the discus to land after release
s_x	the x-component of displacement of the discus at any moment
s_y	the y-component of displacement of the discus at any moment

s_z	the z-component of displacement of the discus at any moment
S	distance (final score)
D	thickness of the discus
V_0	initial speed of the discus
V	the speed of the discus
M	mass of the discus
V_W	the speed of wind
H	attitude of the place

2 Solution and Model

2.1 Question 1

According to the chart provided, three winners had been world-record breaker since the first race in 1984, namely, Felix Limo (18th competition, male athlete), Tirunesh Dibaba (26th competition, female athlete) and Leonard Komon (27th competition, male athlete).

For male athletes: $E[x]=(18+9)/2=13.5$

So the average cost of every race participated by male is $25000/13.5 \approx 1851.85$ euros.

For female athletes: $E[x]=26$

So the average cost of every race participated by female can be calculated as $25000/26 \approx 961.54$ euros.

Consequently, the **total average cost = 1851.85 + 961.54 = 2813.39 euro**.

2.2 Question 2

2.2.1 Assumptions

1) During the whole period of time when it is possible to reach a business deal between the insurance company and the organizing committee, the inflation rate equals to zero.

2) r, the coefficient of the loan remains constant during the whole period of time

2.2.2 Building the model

The average time taken by male athletes to break a world record is about 13.5 years (i.e. a 13.5-year cycle), whereas female athletes need an average of 26 years to do so (i.e. a 26-year cycle).

If we assume that the world record is broken in the first year of the first cycle by male athletes, then the insurance company will give away the bonus of 25,000 euros on behalf of the organizing committee, i.e. the latter now owns the former 25,000 euros.

Hypothetically, the interests earned every moment are directly proportional to the extent of loans, plus the operating cost of the insurance company, which must be gained from the organizing committee as well, and the additional profit attained by the company.

Then, the differential equation of y with respect to x can be written as:

$$\frac{dy}{dx} = ry - k - (z + w)$$

Therefore, y can be represented as the following equation:

$$y_m = r\left(2z + 2w - \frac{25000e^{13.5r}}{r(e^{13.5r} - 1)}\right) + \frac{25000}{e^{13.5r} - 1}e^{rx}$$

$$k = z + w - \frac{25000e^{13.5r}}{r(e^{13.5r} - 1)}$$

$$y_w = r\left(2z + 2w - \frac{25000e^{26r}}{r(e^{26r} - 1)}\right) + \frac{25000}{e^{26r} - 1}e^{rx}$$

$$k = z + w - \frac{25000e^{26r}}{r(e^{26r} - 1)}$$

Thereby each year would repay $C = \frac{25000\,e^{13.5r}}{r(e^{13.5r}-1)} + \frac{25000\,e^{26r}}{r(e^{26r}-1)} + z + w$ euros

Since original average cost is 2813.39 euro, the insurance company will add $\left[\frac{\frac{25000e^{13.5r}}{r(e^{13.5r}-1)}+\frac{25000\,e^{26r}}{r(e^{26r}-1)}+z+w}{28.1339} - 100\right]\%$ to original average cost as the final premium.

2.3 Question 3

2.3.1 Assumptions

1) The value of pm and pw remains constant over this period of time after they have been calculated using the historic data.

2) The degree of difficulty, β, is assumed to be a constant.

3) The number of years is always an integer.

4) The insurance company will invest in other fields using the money they received from the organizing committee to gain higher return.

5) The maximum possible number of times breaking the world record equals to the number of times holding the competition, meaning averagely no more than 1 time the record is broken in one competition.

2.3.2 Building the model

The probability that only one male winner will be able to break the world record in the first 14-year-period is calculated using the binomial distribution, i.e. $\binom{n}{1}{p_m}^{n-1} * (1-p_m)$, and the expected cost of that year will be $\binom{n}{1}{p_m}^{n-1} * (1-p_m) * 25000 * 1$, and so on, for each possible number of times for which the world record is broken when $n \le 14$ and $m < 1$.

During the second 14-year-period, however, it has now become more daunting and challenging for male athletes to set a new world record, since the record is expected to be broken once over the past 14 years, and therefore, we introduced an independent variable, $\beta(\beta > 1)$, to represent the degree of difficulty, which doubles whenever m increases by 1, and the probability that all male athlete will fail to break the world record in the second period will become $p_m * \beta$.

The sum of $E_m(m, N)$ will be the expected cost over N years if the organizing committee chooses to self-insure all the male sport events(where N approaches $+\infty$ in the end).

$$E_m(m,n)$$

$$= \begin{cases} E_1(n) = \beta * n * ({p_m}^{n} * 0 + \binom{n}{1}{p_m}^{n-1} * (1-p_m) * 25000 + \\ \binom{n}{2}{p_m}^{n-2} * (1-p_m)^2 * 25000 * 2 + \cdots + \binom{n}{n} * (1-p_m)^N * 25000n), n \le 14, \mathrm{m} = 1 \\ E_2(n) = \beta^{N-14} * n * ({p_m}^{\mathrm{n}-14} * 0 + \binom{n-14}{1} * {p_m}^{n-15} * (1-p_m) * 25000 + \\ \binom{n-14}{2}{p_m}^{(N-16)} * (1-p_m)^2 * 25000 * 2 + \cdots + \binom{n-14}{n-14} * (1-p_m)^{n-14} * 25000N), 14 \le \mathrm{n} \le 28, \mathrm{m} = 2 \\ \vdots \end{cases}$$

The sum could also be written in this form (for man):

$$E_m(m,n) = \sum_{i=1}^{m}(\sum_{j=0}^{n}\binom{N-14(m-1)}{j} * (p_m * m * \beta)^{[n-14(m-1-j)]} * (1-p_m)^j * 25000j) * 14$$

Likewise, for woman:

$$E_w(m,n) = \sum_{i=1}^{m}(\sum_{j=0}^{n}\binom{n-26(m-1)}{j} * (p_w * m * \beta)^{[n-26(m-1-j)]} * (1-p_w)^j * 25000j) * 26$$

The following equation represents the difference between the expected cost over n years if the committee decides to self-insure and the total insurance cost. If the difference $D > 0$, then it would appear to be more economical if the committee has purchased the insurance; if the difference $D = 0$, then either way is the same in terms of total expenditure. If $D < 0$, then the committee will save more money by self-insuring, i.e. take the risk.

$$D = E_m(m,n) + E_w(m,n) - C$$

For practical purposes ,we further simplify the expected cost into the following equations:

A in a cycle of n years for male athlete:

$$M(p_m) = \sum_{i=0}^{N}\binom{N}{i} * {p_m}^{14-i} * (1-p_m)^i * 25000i$$

A in a cycle of n years for male athlete:

$$W(p_w) = \sum_{i=0}^{N}\binom{N}{i} * {p_w}^{26-i} * (1-p_w)^i * 25000i$$

Then, the total average cost each year if the organizing committee decides to self-insure will be:

$$\mathrm{A} = M(p) + W(p)$$

If $\mathrm{A} > \mathrm{C}$, then committee will be better off if it chooses to purchase the insurance (in this way, however, the cost will not be eliminated but reduced instead); on the other hand, if $A > C * R$, then the insurance company will also benefit from this business deal (Because insurance companies make secondary revenue by investing in the market and therefore, it will close the deal with the organizing committee only if the amount of premium multiplied by the rate of return by investing in the market exceeds average cost each year if the organizing committee decides to self-insure). In conclusion, given the condition of $C < A < C * R$, a business deal will be reached between the two parties.

Therefore, according to this model we can calculated that, when we assume the $z + w$ approximately equals 20% of the average cost 2813.39, $n = 10$, $Pm = 1/14$, $Pw = 1/26$, $Pm = 1/14$ and $r = 0.3$, the advice for the committee would be "should not buy insurance", meaning they should take the risk to self-insure.

2.4 Question 4

In the fourth question, the organizing committee plans to hold 20 men's and 20 women's athletic events, including field events (long jump, high jump, etc.). We have chosen 11 track events (100 meters, 200 meters, 400 meters, 800 meters, 1500 meters, 5000 meters and 10,000 meters 1 combined event (women's heptathlon and men's decathlon) and 8 field events (discus, javelin, hammer, shot put, high jump, long jump, triple jump, pole vault.)

2.4.1 Assumptions

The direction in which the wind is blowing and the speed of the wind both in the four throwing events stay constant during the period of time after release until landing.

The performance of individual athletes during the sport event should reflect his or her normal level of performance, i.e. neither outdo himself nor play below par.

2.4.2 Building the model

Method 1 Aimed at general sport events

As for historic data of former world record progression of these 40 related track and field events, we initially planned to calculate the probability of breaking the world record in both regional and international competitions using relevant information. The drawbacks of doing so, however, is that we are able to deduce the exact number of times at which these competitions were held in previous years, due to the fact that there is such a significant number of regional races and it is an arduous process and almost impossible to track down the specific race in which the record is broken if the race is held within a country, which is true in some cases because certain countries tend to specialize in limited number of sport events.

As a result, we then decided to use the historical data of world record set during the Olympic Games and the World Championships, since the former is believed to be the world's foremost sports competition and winning in the latter competition is considered the highest or near highest achievement in the sport or contest.

The probability that a world record will be broken in these events is calculated as the following and shown in the Excel forms:

$$\frac{the\ \ total\ \ number\ \ of\ \ world\ \ record\ \ set\ \ during\ \ the\ \ competition}{the\ \ total\ \ number\ \ of\ \ times\ \ that\ \ the\ \ compeition\ \ had\ \ been\ \ held}$$

i.e. Pm and Pw

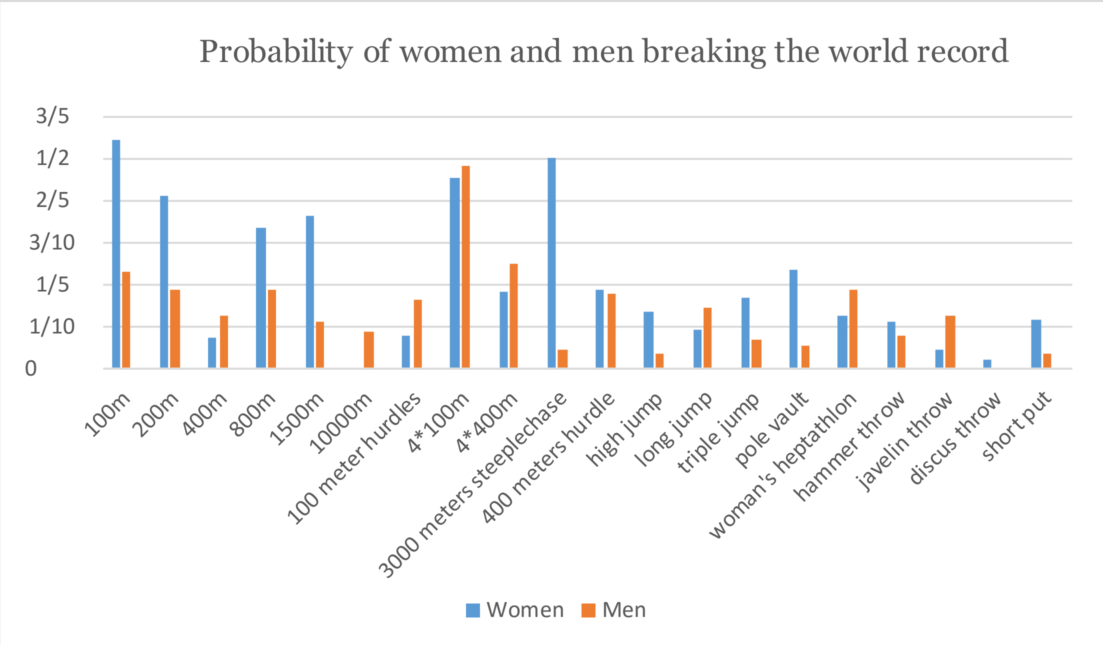


Fig 2.4.2.M1 Probability of women and men breaking the world record

	Women	Men
100m	6/11	31/135
200m	7/17	5/27
400m	14/195	17/135
800m	1/3	5/27
1500m	4/11	1/9
10000m		2/23
100 meter hurdles	13/165	22/135
*4*100m*	5/11	166/345
*4*400m*	2/11	173/690
3000 meters steeplechase	1/2	1/22

400 meters hurdle	3/16	43/240
high jump	3/22	1/27
long jump	47/510	26/179
triple jump	1/6	59/864
pole vault	17/72	1/19
woman's heptathlon	1/8	64/345
hammer throw	1/9	1/13
javelin throw	28/615	1/8
discus throw	1/43	
short put	2/17	1/27

Table 2.4.2.M1 Probability of women and men breaking the world record

Then we can substitute the value of pm and pw back into the equation where D is calculated and compared with 0 to use the same criteria as is suggested in the third question.

Method 2 Particularly aimed at the four throwing events

There are four throwing events in regular track and field competitions, which are discus throw, shot put, javelin and hammer throw. The probability that athletes will break any world record in these four throwing events depends on several variables (especially environmental factors), including the angle of release, the wind speed present, and altitude.

Assumed that the discus will only have a horizontal velocity immediately after release, and the z-component is used to describe the height at which the discus will be travelling in the air.

The relationships between the variables listed above can be summarized as below:

$$\rho = 1.293 \times \frac{p_0 (1 - \frac{h}{44330})^{5.255}}{p_0} \times \frac{273.15}{298.15 - 0.006h}$$

$$A = 0.22d$$

$$a_x = \frac{A\rho(v_w \cos\alpha - v\cos\theta\cos\beta)^2}{m}$$

$$a_y = \frac{A\rho(v_w \sin\alpha - v\cos\theta\sin\beta)^2}{m}$$

$$a_z = \frac{-A\rho(v\cos\beta\sin\theta)^2}{m} - g$$

$$v_x = v_0\cos\theta + a_x t$$

$$v_y = a_y t$$

$$v_z = v_0\sin\theta + a_z t$$

$$v = \sqrt{{v_x}^2 + {v_y}^2 + {v_z}^2}$$

$$\cos\theta = \frac{dv_x}{\sqrt{{dv_x}^2 + {dv_z}^2}}$$

$$\sin\theta = \frac{dv_z}{\sqrt{{dv_x}^2 + {dv_z}^2}}$$

$$\cos\beta = \frac{dv_x}{\sqrt{{dv_x}^2 + {dv_y}^2}}$$

$$\sin\beta = \frac{dv_y}{\sqrt{{dv_x}^2 + {dv_y}^2}}$$

$$t = \frac{2mv_0\sin\theta}{A\rho(v\cos\beta\sin\theta)^2 - mg}$$

$$s_x = v_0 t\cos\theta + \frac{a_x t^2}{2}$$

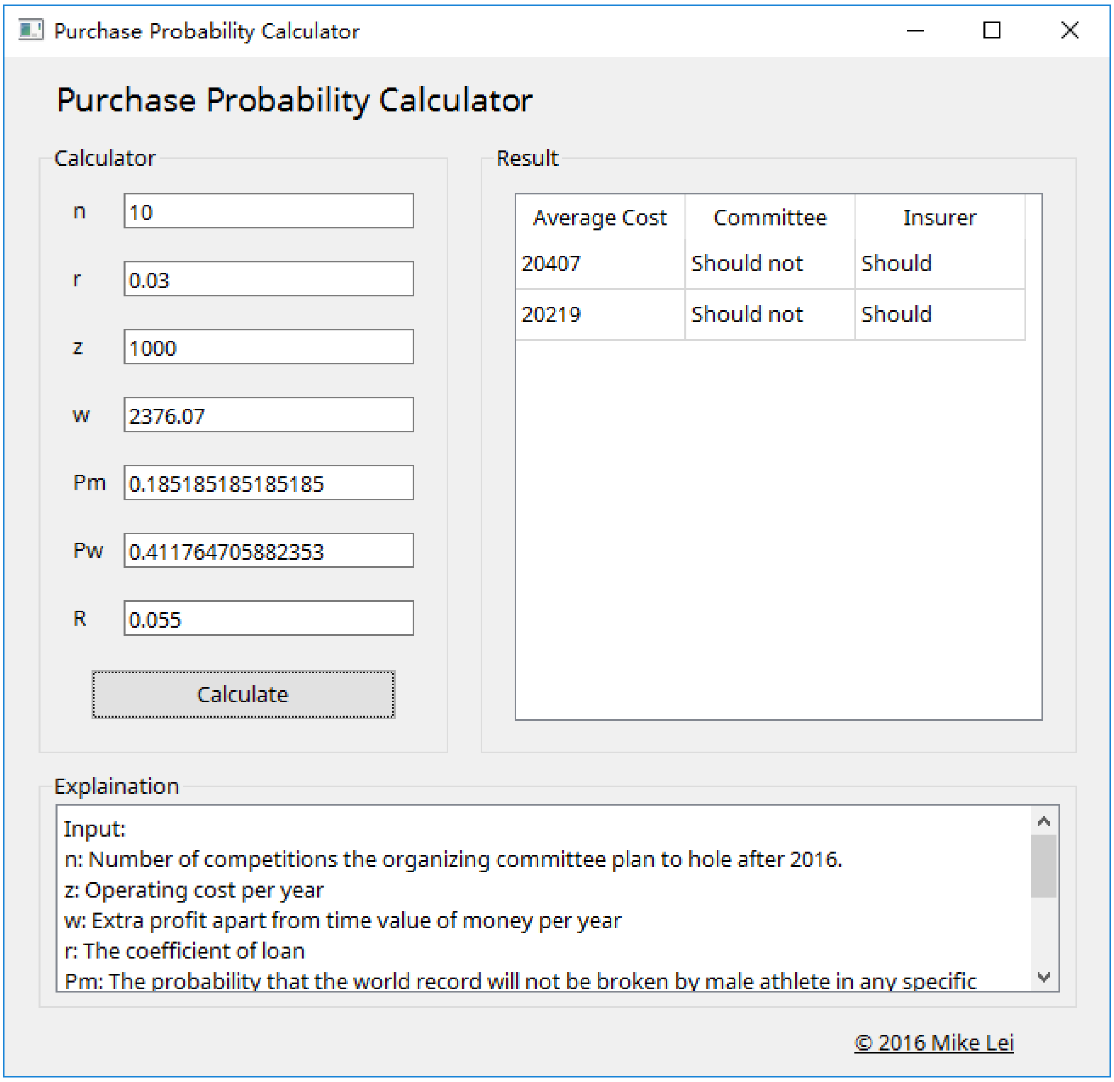
$$s_y = \frac{a_y t^2}{2}$$

$$\mathbf{s} = \sqrt{{\mathbf{s}_x}^2 + {\mathbf{s}_y}^2}$$

Then the distance of which the discus can reach can be calculated using the following derived formula, and can be later compared with world record prior the year in which the competition is held to decide whether the top-performer in the competition is able to break the record.

2.5 Question 5

According to the question, it would be beneficial for the committee to use an understandable form to efficiently determine whether they should buy insurance or not. Therefore, an easy program with GUI (Graphical User Interface) tends to the best choice to be easily interpreted and operated. Also, since the limited time we have, our programmer chooses to write the core function of the program with Python, one of the highest-level language as well as the GUI powered by Qt and PyQt4 to ease and accelerate the process of programming.



Picture 2.5 The Purchase Probability Calculator

As can be seen, this application contains three parts. On the left is the input section, including variables n, r, z, w, Pm, Pw and R, which are explained at the lower half of the dialogue. On the right is the output section in terms of a sheet including the average cost calculated and also the suggestions for both committee and insurer. When the committee wants to know whether they should buy insurance on a certain competition, all they have to do is simply inputting variables respectively and click the button “Calculate”, then the results would be immediately shown up on the result section.

3 Strength and limitations

3.1 Advantages

3.1.1 Model of Question 2

a) A wide range of variables are taken into account

3.1.2 Model of Question 3

a) Not only can the committee use to determine whether they should buy the insurance or not, it is also possible for the insurance company to decide if they can afford the risk of losing money for high amount of prizes, which is seemly closer to the reality.

b) In the beginning, the function we developed is over complicated. After simplifying this function, although the input value may contain some errors compared with the real one (which is heavily influenced by many other factors in reality), the outcome may be closer to the expected one comparing with using over complicated functions.

3.1.3 Model of Question 4

a) Environmental factors are also taken into account in four throwing sport events, including the air resistance, the direction in which the wind is blowing and its speed.

b) The release of the object in considered in terms of three dimensions, including upward movement and three kinds of angles related to the movement.

3.2 Disadvantages

3.2.1 Model of Question 2

a) Many variables are considered as constants, such as the operating cost and additional profit, which are in fact hard to determine while simulating in real situations.

3.2.2 Model of Question 3

a) It is not accurate enough since the occasion that world record is broken more than twice excessively is not taken into account.

3.2.3 Model of Question 4 Method 2

a) We failed to give an exact analytical solution of the physical quantities related to the angles, and there is still possible improvement in terms of simplification that could be done to the over complicated equation.

b) Determining the probability that any athletic event will be broken at the Olympic Games and the World Championships is in fact a lot more complex by only considering the number of world records set during these competitions. Other variables, such as the cutting-edge technology adopted in the athletes' clothes, shoes, or environmental factors (such as the humidity, temperature, headwinds, altitude at which the competition is held, etc.) should also be considered. However, their importance in determining the probability has been eliminated (except for the four throwing field events), so it is very likely that pm and pw fail to resemble the true value of these probabilities.

3.3 Portability Analysis

The method 1 in the solution to the fourth question is generally agreed to have relatively high portability. Since the probability of breaking the world record on one competition is calculated according to the previous data, which can be easily found on the internet for almost every kinds of competition. However, the second question is seemly not really transferable since it can be treated as a pure physical problem which could only be linked to throw games, and each kind of throw games may have different equipment, which will considerably decrease the accuracy of the results.

4 References

[1] 《数学模型》 姜启源第四版 高等教育出版社 ISBN：9787040311501

[2] 《数学建模算法与应用》 司守奎，孙玺菁 著 国防工业出版社 ISBN：9787118076479

[3] 12th IAAF World Championships in Athletics: IAAF Statistics Handbook. IAAF (2009). Retrieved on 2011-05-07

5 Appendix

5.1 Source Code

Notice: All source codes are open sourced under GNU Public License v3 and available here: https://github.com/mikelei8291/IMMC2016

5.1.1 Source Code of Question 2

A program to plot a graph of Question 2

Plot.py

```
import numpy as np
import matplotlib.pyplot as plt
import pylab

def f(x):
    z = 500
    w = 800
    return -
(26661.1+10.5322*(z+w))*np.e**(0.049*x)+(51661.1134+20.4082*(z+w))

x = np.linspace(0, 14, num = 14)
y = f(x)
print(f(x))
pylab.show(plt.plot(x,y))
```

5.1.2 Source Code of Question 3

```
from scipy.misc import comb
from math import e

r = 0.03
z = 5618.00
w = 107061.00
Pm = 1/14
Pw = 1/26
R = 0.055 + 1
sumM = 0
sumW = 0

C = (25000*e**(13.5*r))/(r*(e**(13.5*r)-
1))+(25000*e**(26*r))/(r*(e**(26*r)-1))+z+w

for i in range(0,15,1):
    M=comb(14, i)*Pm**(14-i)*((1-Pm)**i)*25000*i
    sumM += M
for j in range(0,27,1):
    W=comb(26, i)*Pw**(26-i)*((1-Pw)**i)*25000*i
    sumW += W
A = sumM + sumW

if C*R > A > C:
    print("Deal!")
if C > A:
    print("Committee should not!\nInsurer should!")
if A > C*R:
    print("Committee should!\nInsurer should not!")
```

5.1.3 Source Code of Question 4

Method 1 A Python program to calculate the "Should/Should not" result automatically with plain text files input and plain text files output for the result.

(On the next page)

```
from scipy.misc import comb
from math import e

n = 10
r = 0.03
z = 1000
w = 2376.07
R = 0.055
RawPm = open("./Raw/Pm.txt")
RawPw = open("./Raw/Pw.txt")
ResultC = open("./Result/ResultCommittee.txt", "w")
ResultI = open("./Result/ResultInsurer.txt", "w")
dataRow = int(input("Input the total amount data you want to
calculate: "))

for k in range(0,dataRow,1):
    Pm = float(RawPm.readline())
    Pw = float(RawPw.readline())
    C = float((25000*e**(n*r))/(r*(e**(n*r)-
1))+(25000*e**(26*r))/(r*(e**(26*r)-1))+z+w)
    sumM = 0.0
    sumW = 0.0
    for i in range(0,n+1,1):
        M = float(comb(n, i)*(1-Pm)**(14-i)*(Pm**i)*25000*i)
        sumM += M
    for j in range(0,n+1,1):
        W = float(comb(n, i)*(1-Pw)**(26-i)*(Pw**i)*25000*i)
        sumW += W
    A = sumM + sumW
    if C*(R+1.0) > A > C:
        ResultC.write("Deal\n")
        ResultI.write("Deal\n")
    if C > A:
        ResultC.write("Should not\n")
        ResultI.write("Should\n")
    if A > C*(R+1.0):
        ResultC.write("Should\n")
        ResultI.write("Should not\n")
    print("Recorded!")
ResultC.close()
ResultI.close()
RawPm.close()
RawPw.close()
print("Process finished!")
```

5.1.4 Source Code of Question 5

The Purchase Probability Calculator with GUI.

It has two parts: the core of calculation and the code to generate GUI.

Calculation core:

core5.py

```
from scipy.misc import comb
from math import e

def C(r,z,w,n):
    C = float((25000*e**(n*r))/(r*(e**(n*r)-
1))+(25000*e**(26*r))/(r*(e**(26*r)-1))+z+w)
    return C

def A(Pm,Pw,n):
    sumM = 0.0
    sumW = 0.0
    for i in range(0,n+1,1):
        M = float(comb(n, i)*(1-Pm)**(14-i)*(Pm**i)*25000*i)
        sumM += M
    for j in range(0,n+1,1):
        W = float(comb(n, i)*(1-Pw)**(26-i)*(Pw**i)*25000*i)
        sumW += W
    A = sumM + sumW
    return A
```

GUI:

`main.py`
(On the next page)

```
import core5
import sys
from PyQt4 import QtCore, QtGui, uic

qtCreatorFile = "ui.ui"
Ui_MainWindow, QtBaseClass = uic.loadUiType(qtCreatorFile)
class Decition(QtGui.QMainWindow, Ui_MainWindow,
QtGui.QTableWidget):
    def __init__(self):
        QtGui.QMainWindow.__init__(self)
        Ui_MainWindow.__init__(self)
        self.setupUi(self)
        self.Calculate.clicked.connect(self.CalculatePcs)

    def CalculatePcs(self):
        r = float(self.r.text())
        z = float(self.z.text())
        w = float(self.w.text())
        Pm = float(self.Pm.text())
        Pw = float(self.Pw.text())
        n = int(self.n.text())
        R = float(self.R.text())
        C = core5.C(r,z,w,n)
        A = core5.A(Pm,Pw,n)
        if C*(R+1) > A > C:
            Committee = QtGui.QTableWidgetItem("Deal")
            Insurer = QtGui.QTableWidgetItem("Deal")
        if C > A:
            Committee = QtGui.QTableWidgetItem("Should not")
            Insurer = QtGui.QTableWidgetItem("Should")
        if A > C*(R+1):
            Committee = QtGui.QTableWidgetItem("Should")
            Insurer = QtGui.QTableWidgetItem("Should not")
        ResultA = QtGui.QTableWidgetItem("%d" %A)
        self.ResultTable.insertRow(0)
        self.ResultTable.setItem(0, 0, ResultA)
        self.ResultTable.setItem(0, 1, Committee)
        self.ResultTable.setItem(0, 2, Insurer)

if __name__ == "__main__":
    app = QtGui.QApplication(sys.argv)
    window = Decition()
    window.show()
    sys.exit(app.exec_())
```