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Research article

Information Dynamics in FIFA Women's World Cup Germany 2011 Final

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Abstract

This paper is concerned with information dynamics in FIFA Women's World Cup Germany 2011 Final Japan vs. America. It has been confirmed that though Japan wins in the game America keeps the advantage through the game, and so Japan's victory is miraculous. It is concluded that invincible attachment to the holy victory plays crucial role in this historical Soccer game.

Keywords: Information Dynamics, Soccer, Shogi, Entertainment, Game theory

1. Introduction

Entertainment must be an emotion that oozes out of our minds like a water spring, during the process in which we are going to accomplish ambition, dream and/or target. It is, therefore, expected that the higher the ambition is, the greater the dream is, and the more difficult to reach the target is, the higher or the deeper the quality of entertainment during the process is.

Even our life is, perhaps, a game, so it is, indeed, part of our life. Non the less, until very recently, there exists no mathematical model that can predict how game information varies with time from start to end. Keeping in mind this fatal deficit in game theory, we have engaged in developing models for last few years(Iida et al 2011). Contrary to Shannon(1948), our approach is to view information particles. The validity of our information dynamic models have been already confirmed by Iida et al (2011), Iida & Nakagawa (2011), and others.

The main purpose of the present study is to analyze FIFA Women's World Cup Germany 2011 Final: Japan

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vs. America to discuss quality of the entertainment.

2. Information Dynamic Models

Based on fluid mechanics (Batchelor et al 2000), the following two information dynamic modes are derived.

Model for certainty of game outcome (Iida et al 2011): $\xi_c = \eta^m$,

where ξ_c is certainty of game outcome, η non-dimensional game length, and m positive real number.

Model for uncertainty of game outcome (Iida & Nakagawa 2011): $\xi_u = (1 - \eta)^q$,

Where ξ_u is uncertainty of game outcome, and q positive real number.

The usefulness of these models has been illustrated by using the 69th Professional Shogi Player's Championship Series the 7th game Habu vs. Moriuchi.

3. The Final: Japan vs. America

In this section, the Final: Japan vs. America is analyzed first, and then it will be discussed how advantage, winning rate, and certainty or uncertainty of game outcome vary with increasing the game length.

Before conducting any data analysis, the game results is summarized in Table 1.

Table 1: FIFA Women's World Cup Germany 2011 Final: Summary of Results

	0 − 0				
	1 − 1				
Japan	Ext.	America			
	0 − 1				
	1 − 0				
Miyama(81)		Morgan(69)			
Sawa(117)		Onebag(104)			
	PK match				
	Miyama	Nagasato	Sakaguchi	Kumagai	
Japan	○	x	○	○	3
America	x	x	x	○	1
	Box	Rloyd	Heath	Onebag	

3.1 Game Outlook:

The Final starts with kick-off by Japan. Once the game starts, whenever Japan applies the pressure on America, the offensive force is easily dodged by the latter. Owing to the rigid defense system of America, Japanese can't maintain the pass work. Until 30 minutes from the kick-off, America has critical goal chances seven times, but she never succeed to get any goal only by their shoots hitting either the cross-bar or goal posts. Though Japan encounters such severe attacks by America, all of Japanese players including superintendent, Sasaki and coaches keep their heads cool, so that the first half finishes by the score nil to nil.

After 10 minutes break, America restarts their severe attack against Japan, and so America keeps her pace. Following a beautiful counter attack, American striker, Morgan gets the first goal at 69 minutes. On the other hand, Japanese players never give up the brilliant victory and maintain the highest tension and noble will towards their dream. Accordingly at 81 minutes, the second goal arises from the energetic activities and marvelous creativities by the two substitutes: Nagasato receives the ball at the right-side, and sends the cross-ball to the left-side. Responding to it, Maruyama tries to make a serious charge against opponent players. This incurs clear miss of American player. Japanese mid-fielder, Miyama traps the ball, and shoots a ball with her left foot. This goal lets the game balanced again.

The game enters in the extension by the score 1:1. At 104 minutes, an American player intercepts the cleared ball and passes it to the American super striker, Onebag, who makes a clean shoot. America takes her second lead at the stage, time is left only 16 minutes. Japanese players are obliged to cope with a hopeless situation, but our Nadeshiko endures difficulties without loosing calm in mind as well as strong will to the victory. Then, Japan is given a corner-kick from the left: Rushing to the ball kicked by Miyama, Japanese ace-striker, Homare Sawa runs towards the left goal area, and gets the reversed goal by pushing the ball at the outside of her right foot.

After entering PK-match, Japanese guardian, Kaihori blocks opponent shoot twice, and incurs miss kick once. Accordingly, within four American kickers only Onebag succeeds the shoot. At the point of time that four American kickers and three Japanese kickers have completed their trials, Japan gets two goals while America one goal. Finally, the fourth Japanese kicker, Kumagai takes the remarkable winning goal: Japan wins the game.

It has been reported that Kawasumi leaves us such an interesting message immediately after the game" Today's our victory may be only possible to appear either in a certain comic story, novel or movie, but not in the actual". As being symbolized by the message, Nadeshiko-Japan has a miraculous victory, to be recorded in the World Soccer history. This game posses a permanent value in the human history ; our Nadeshiko has accomplished one of their many dreams. Captain, Homare Sawa says " Dream is not to see, but to grasp with actual hands".

3.2 Data Analyses

Non-dimensional advantage $\alpha(\eta)$ is defined as

$$\alpha(\eta) = [S_J(\eta) — S_A(\eta)]/S_T \quad \text{for } 0 \leq \eta \leq 1,$$

where $S_J(\eta)$is the current goal sum of Japan, $S_A(\eta)$the current goal sum of America, S_T the total goals during the game, and $\eta$the non-dimensional game length. The sign of non-dimensional advantage $\alpha(\eta)$ is defined to be positive when Japan gets an advantage, while it is negative when America an advantage.

Winning rates for Japan and America, respectively, are defined as

$p_J(\eta)=[1+\alpha(\eta)]/2,$

and

$p_A(\eta)=[1-\alpha(\eta)]/2.$

Fig.1 shows how non-dimensional advantage $\alpha(\eta)$, Japan winning rate $p_J(\eta)$, andAmerican winning rate $p_A(\eta)$ depend on non-dimensional game length η.

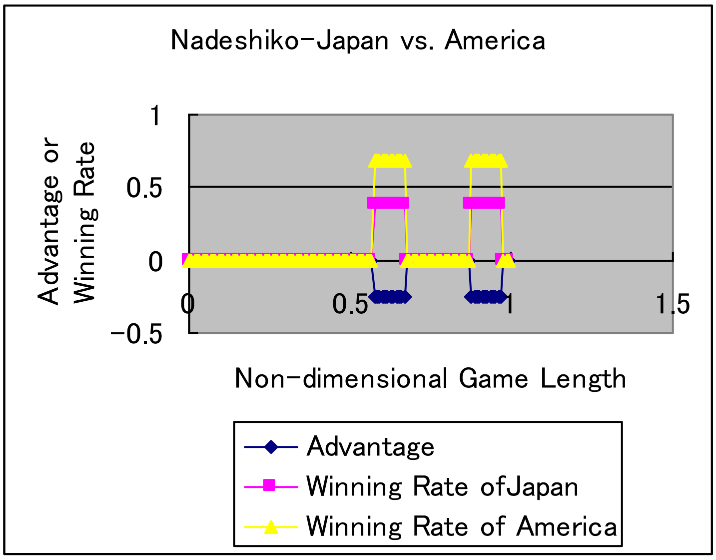

Figure 1: Non-dimensional advantage $\alpha(\eta)$, winning rate of Japan $p_J(\eta)$, or winning rate of America $p_A(\eta)$ against non-dimensional game length η.
--:Advantage, …: Japan winning rate, -.-.: America winning rate

Advantageous certainty of game outcome $\xi_{ac}(\eta)$ is defined by

$$\xi_{ac}(\eta)=\begin{cases}|\alpha(\eta)| & \text{for } 0\le\eta<1,\\ 1 & \text{for } \eta=1.\end{cases}$$

On one hand, logarithmic certainty of game outcome $\xi_{lc}(\eta)$ is defined as follows,

$$\xi_{lc}(\eta)=1+\sum_{i=1}^{2} p_i(\eta)\log_2 p_i(\eta) \quad \text{for } 0\le\eta<1,$$
$$=1 \quad \text{for } \eta=1,$$

where i is a positive integer.

Fig.2 illustrates how certainty of game outcome ξ_c (η) varies with increasing non-dimensional game length η during the Final.

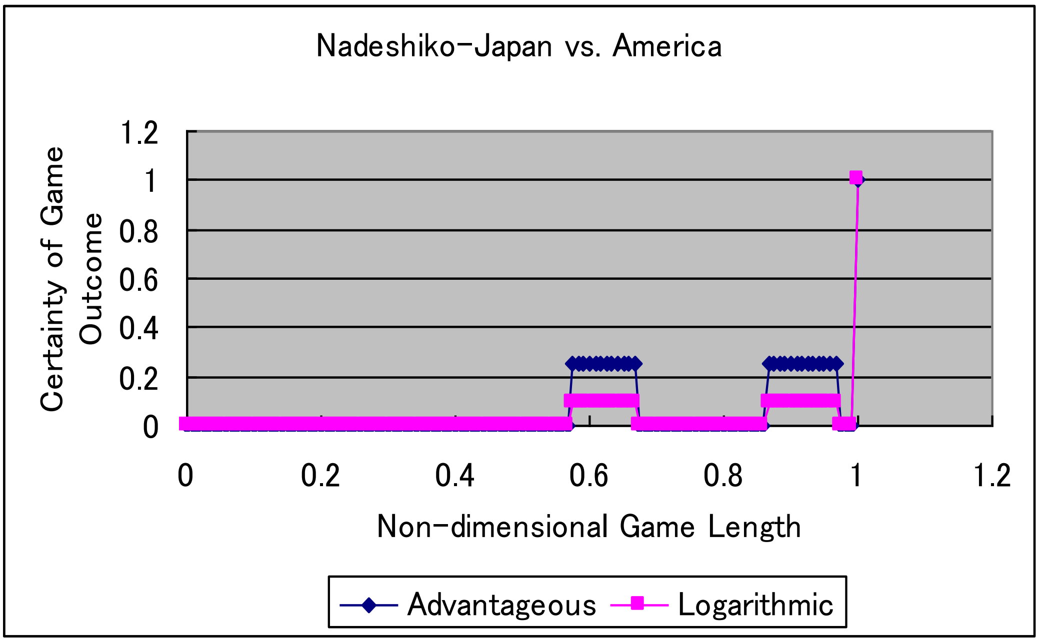

Figure 2: Certainty of game outcome ξ_c (η) against non-dimensional game length η.
----:Advantageous certainty, …:Logarithmic certainty

Advantageous uncertainty of game outcome ξ_{au} (η) is defined as follows,

$$\xi_{au}(\eta) = 1 - |\alpha(\eta)| \quad \text{for } 0 \le \eta < 1,$$
$$0 \quad \text{for } \eta = 1.$$

On one hand, logarithmic uncertainty of game outcome ξ_{lu} (η) is defined by

$$\xi_{lu} = -\sum_{i=1}^{2} p_i(\eta)\log_2 p_i(\eta) \quad \text{for } 0 \le \eta < 1,$$
$$= 0 \quad \text{for } \eta = 1,$$

where i is a positive integer.

Fig.3 indicates how uncertainty of game outcome ξ_u (η) varies with increasing the non-dimensional game length η during the Final.

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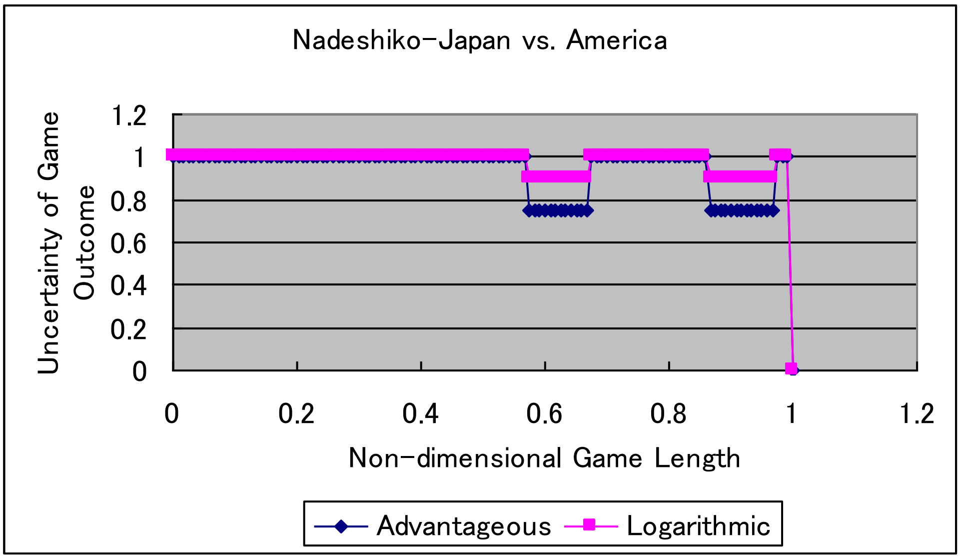

Figure 3: Uncertainty of game outcome ξ_u (η) against non-dimensional game length η.
---:Advantageous uncertainty, …:Logarithmic uncertainty

4. Conclusion

New knowledge and insights obtained through the present study have been summarized as follows;

(a) The results of FIFA Women's World Cup Germany 2011 Final have shown that though Japan wins the game, the actual situation is that America keeps the advantage through out the game, so that Japan's victory is miraculous. That is, Japan takes an advantage for the first time at the very end of game when Miyama succeeds the penalty kick as the fist Japanese kicker in PK match.

(b) The Final must be recorded in human history as a typical game, in which deep attachment to dream or ambition plays crucial role in determining victory or defeat. This game has instructive value, and encourage all of us whether they are young or old.

(c) The usefulness of information dynamic models has been illustrated by using the 69th Professional Shogi Player's Championship Series the 7th game Habu vs. Moriuchi: The best fit curve for certainty of game outcome ξ_c is found to be

$$\xi_c \simeq \eta^{115},$$

while that for uncertainty of game outcome ξ_u is

$$\xi_u \simeq (1-\eta)^{0.0346},$$

where η is non-dimensional game length.

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Appendix the 69th Professional Shogi Player's Championship Series the 7th Game

Habu vs. Moriuchi

Shogi is a popular Japanese board game, and it is similar to Chess. Table A1 lists all the Shogi pieces in English as well as Japanese.

Table A1 Shogi pieces in English as well as Japanese.

King	Gold-General	Silver-General	Knight	Rook	Bishop	Lance	Pawn
王	金	銀	桂馬	飛車	角	香車	歩

Game outlook: No.33th move, Moriuchi applies 7 七 Knight, and then Habu examines that move and then it becomes lunch break.

No.50th move, Habu puts 6 四 Pawn. At this position, after thinking for one hour and 50 minutes Moriuchi choses no.51th move, the last move in the first session of a two-session game. Habu puts no.52th move, 5 三 Silver−General after thinking for one hour and 36 minutes.

As no.52th move, Habu puts 7 一 Bishop. At this position, after thinking the best move for one hour and 24 minutes, they take lunch break. Moriuchi decides no.59th move as 8 二 Pawn after thinking for one hour and 52 minutes.

Habu selects the move, 5 五 Pawn. At this position, after thinking for 33minutes,
Moriuchi gets a rest. Against no.123th move, 5 五 Silver General due to Moriuchi, Habu resigns after one minute thought.

As the result, Challenger Moriuchi wins the game.

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All of the data used for the present analyses are evaluation function scores for each the move, which are evaluated by a computer engine, called "Gekisashi". This engine counts elements relating to the game outcome faithfully, and then sums them to get the evaluation function scores(Tsuruoka et al 2002, Tsuruoka 2005, David-Tabibi et al 2008).

Sign of the advantage is defined as positive when Moriuchi gets the advantage, while it is negative when Habu takes the advantage。 The non-dimensional advantage of Shogi $\alpha(\eta)$ is defined as

$$\alpha(\eta) = Ad(\eta)/ACT(1) \text{ for } 0 \leq \eta \leq 1,$$

where $Ad(\eta)$ is the advantage, that is the evaluation function scores. $ACT(1)$ is the total advantage change in the game, and $ACT(\eta)$ is defined by

$$ACT(\eta)=ACT(m/N)=\sum_{1 \leq i \leq m} |Ad(i) - Ad(i-1)|,$$

where m is current number of move, N the total number of move, and i the positive integer. Also, $\eta = m/N$ is the non-dimensional game length.

Winning rates $p_1(\eta)$ and $p_2(\eta)$ of Moriuchi and Habu are defined , respectively, as

$$p_1(\eta) = [1 + \alpha(\eta)]/2,$$

and

$$p_2(\eta) = [1 - \alpha(\eta)]/2.$$

Fig.A1 shows how non-dimensional advantage $\alpha(\eta)$, winning rate $p_1(\eta)$, and winning rate $p_2(\eta)$ depend on non-dimensional game length η. Until $\eta \simeq 0.25$, both winning rates are 0,5, and so they are balanced. However, from$\eta \doteqdot 0.25$ to 0.35 , Habu gets advantage, and then until$\eta \doteqdot 0.53$ Moriuchi gets advantage. From$\eta \doteqdot 0.53$ to 0.64, Habu regain advantage. Though between$\eta \doteqdot 0.68$ and 0.75 , this game is balanced, after$\eta \doteqdot 0.75$ Moriuchi keeps his advantage, experiencing such variation as noticed on this figure and arrives at the win finally.

Advantageous certainty of game outcome may be defined as follows,

$$\xi_{ac} = |\alpha(\eta)| \text{ for } 0 \leq \eta < 1,$$
$$= 1 \text{ for } \eta = 1.$$

On one hand, logarithmic certainty of game outcome is defined by

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$$\xi_{lc}(\eta) = 1 + \sum_{i=1}^{2} p_i(\eta)\log_2 p_i(\eta) \text{ for } 0 \leq \eta < 1,$$
$$= 1 \quad \text{for } \eta = 1.$$

Fig. A2 shows the relation between certainty of game outcome $\xi_c(\eta)$ and non-dimensional game length η. Owing to the character of logarithmic value, it is considered that logarithmic certainty of game outcome ξ_{lc} only provides its order, but not itself. This is why logarithmic certainty of game outcome ξ_{lc} is always smaller than advantageous certainty of game outcome ξ_{ac}. Since advantageous certainty of game outcome ξ_{ac} is considered to be wanted certainty of game outcome, we obtain the best fit curve by using the least square method as

$$\xi = \eta^{115}.$$

Advantageous uncertainty of game outcome $\xi_{au}(\eta$ is defined as

$$\xi_{au}(\eta) = 1 - |\alpha(\eta)| \text{ for } 0 \leq \eta < 1,$$
$$= 0 \quad \text{for } \eta = 1.$$

On one hand, logarithmic uncertainty of game outcome is expressed by

$$\xi_{lu}(\eta) = -|\sum_{i=1} p_i(\eta)\log_2 p_i(\eta) \text{ for } 0 \leq \eta < 1,$$
$$= 0 \quad \text{for } \eta = 1.$$

It is realized that by using the least square method the best fit curve for advantageous uncertainty of game outcome is expressed by

$$\xi = (1-\eta)^{0.03459}$$

Fig. A3 shows relation between uncertainty of game outcome $\xi_u(\eta)$ and game length η. In this figure, advantageous uncertainty of game outcome ξ_{au} as well as logarithmic uncertainty of game outcome ξ_{lu} have been plotted concurrently. The best fit curve of uncertainty of game outcome has been calculated by using the least square method as follows,

$$\xi = (1-\eta)^{0.03459}.$$

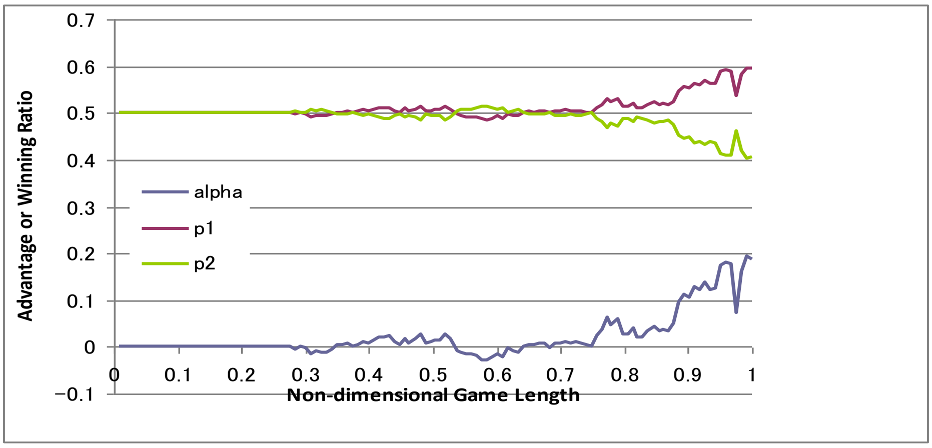

Fig. A1 Non-dimensional advantageα(η)、 and winning rate p $_1$(η), or p $_2$(η) againstnon-dimensional game lengthη

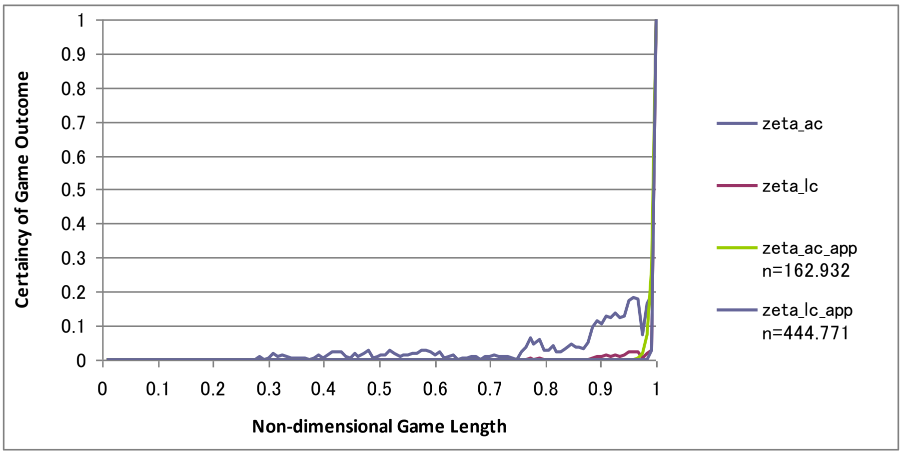

Fig.A2 Certainty of game outcomeξ$_c$(η) against non-dimensional game lengthη

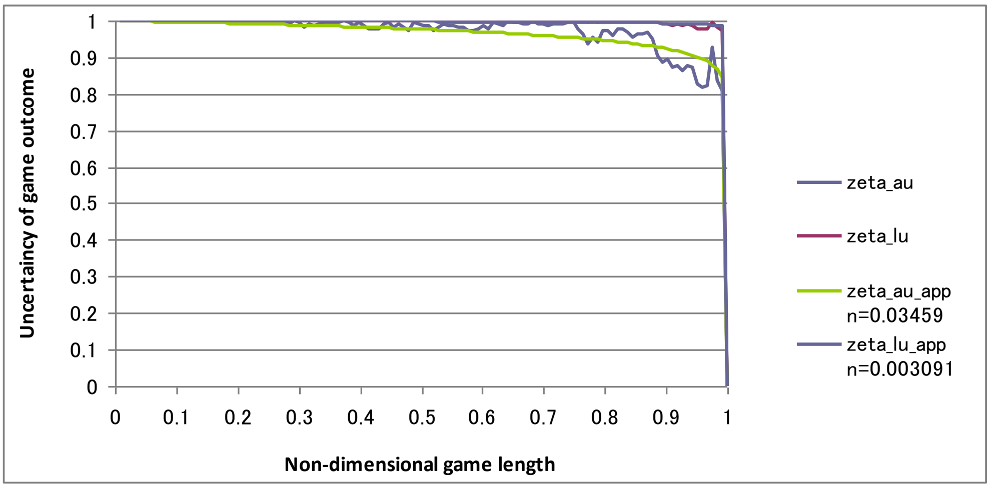

Fig.A3 Uncertainty of game outcomeξ$_u$(η) against non-dimensional game length η