The Tournament Handbook

Volume 1: Tournament Scheduling

Edition 1.0

August 2016

by

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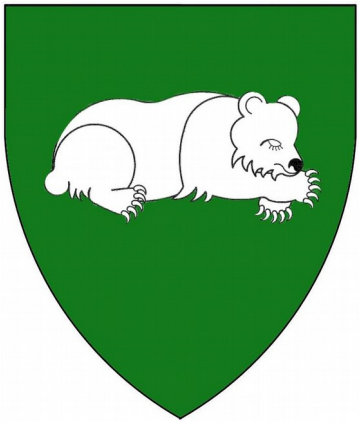

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Dedication

I dedicate this work to my wife Pam (also known as Arcadia) who patiently listened to me rant and rave about the mathematics and simulation of tournaments for months…

Acknowledgments

Mike Williams (Logan)

Stephanie Williams (Dearbháil inghean Léoid)

Tatiana Goss (Tatiana Bonacieux)

Introduction

“Don't parry with your face.” – Tristan Grey of Manchester

This handbook arose from an argument regarding how long an SCA tournament consisting of X fighters run on Y fields would take to run. At the end of the argument, I was tasked to create a manual on SCA tournaments to accurately estimate how long an SCA tournament of X fighters on Y fields would take to run. The manual could be used to reality check proposed tournaments, improved event scheduling, and allow comparison of tournament formats.

Unfortunately, SCA tournaments aren't like most other tournaments in sports and gaming [ROK]. SCA tournaments don't use a single format for all tournaments. SCA tournaments are expected to run very quickly with most tournaments being less than 3 hours in length. The number of participants in SCA tournaments varies widely and there is very little seeding. Finally, the handling of byes and ties during competition is almost unique to the SCA. So when I started researching tournament scheduling, I quickly realized that most of the existing work wasn't suitable for use in scheduling SCA tournaments.

So I started from scratch…

Using the Handbook

The handbook is split into two main parts. In the first part, I provide a set of worksheets that provide simple access to the underlying tournament models. The worksheets guide the user so they just have to plug in some numbers and do some arithmetic to get the numbers they're looking for.

The second part of the handbook focuses on the derivation of the tournament models. I used applied combinatorics, graph theory, and queuing theory to derive the models and then implemented a virtual tournament simulator in C# to provide numerical simulation and validation of tournament models. If you've got a background in mathematics, hard science, or engineering, you should be able to understand the tournament models and the assumptions that constrain them.

Tournament Worksheets

These worksheets allow someone interested in scheduling a tournament to estimate several different tournament metrics. The primary metric is the estimated tournament time since a successful tournament must run on time and on schedule to even remotely be considered a success. The other metrics allow tournament planners to make tournaments more enjoyable for the fighters participating.

Estimated Bout Time Worksheet

This worksheet estimates the time of a single bout in an SCA tournament.

1. Enter an estimate for a single fight (T_{fight}) in minutes.	1	_____
2. Is the tournament being fought "best-of-3"? 2a. Yes. Enter **2.7** on line 2. 2b. No. Enter **1** on line 2.	2	_____
3. Multiple line 1 and line 2.	3	_____
4. Estimate the non-combat time for the bout.		
4a. Enter an estimated time for heraldry in minutes.	4a	_____
4b. Enter an estimated time for salutes in minutes.	4b	_____
4c. Enter an estimated time for satisfaction in minutes.	4c	_____
5. Add lines 3, 4a, 4b, and 4c. This is the estimated bout time (T_{bout}) in minutes.	5	_____

Estimated Bout Time (T_{bout}): _____

Bout Time Worksheet

This worksheet estimates the time of a single bout in an SCA tournament.

1. Enter an estimate for a single fight (T_{fight}) in minutes.	1	2 min
2. Is the tournament being fought "best-of-3"? 2a. Yes. Enter **2.7** on line 2. 2b. No. Enter **1** on line 2.	2	1
3. Multiple line 1 and line 2.	3	2
4. Estimate the non-combat time for the bout.		
4a. Enter an estimated time for heraldry in minutes.	4a	0.33 min
4b. Enter an estimated time for salutes in minutes.	4b	0.5 min
4c. Enter an estimated time for satisfaction in minutes.	4c	0.25 min
5. Add lines 3, 4a, 4b, and 4c. This is the estimated bout time (T_{bout}) in minutes.	5	3 min

Estimated Bout Time (T_{bout}): 3 min

Heraldy = 20 s = 0.33 min

Salutes = 30 s = 0.5 min

Satisfaction = 15 s = 0.25 min

Elimination Tournament Time Worksheet

1. Enter the estimated number of fighters (n).	1	_____
2. Enter the estimated number of fields (f).	2	_____
3. Look up the number of rounds from the bout counts table for the estimated fighters. Single: ***Single Elimination Bout Counts*** Double: ***Double Elimination Bout Counts*** Triple: ***Triple Elimination Bout Counts***	3	_____
4. Look up the bout count from the bout counts table for the estimated fighters and fields.	4	_____
5. Does the tournament switch to a single field for the final rounds? 5a. Tournament only has one field. Enter **0** on line 5. 5b. Yes (quarter-finals). Enter **3** on line 5. 5c. Yes (semi-finals). Enter **1** on line 5. 5d. No. Enter **0** on line 5.	5	_____
6. Add line 4 and line 5.	6	_____
7. Enter the estimated bout time (T_{bout}) in minutes. Use a known time or complete the ***Bout Time Worksheet*** to generate the estimate bout time.	7	_____
8. Multiply line 6 and line 7 and divide by **60**. This is the estimated combat time (T_{combat}) in hours.	8	_____
9. Enter the estimated non-combat time ($T_{non-combat}$) in hours.	9	_____
10. Add line 8 and line 9.	10	_____

This is the estimated tournament time ($T_{tournament}$) in hours.		

Minimum Bouts: 1 (single), 2 (double), 3 (triple)

Maximum Bouts: _____ (line 3)

Estimated Combat Time (T_{combat}): _____ (line 8)

Estimated Non-Combat Time ($T_{non-combat}$):_____ (line 9)

Estimated Tournament Time ($T_{tournament}$):_____ (line 10)

Round-Robin Tournament Time Worksheet

1. Enter the estimated number of fighters (n).	1	_____
2. Enter the estimated number of fields (f).	2	_____
3. Enter the number of rounds (r). 3a. Enter line 1 minus **1** if line 1 is even. 3b. Enter line 1 if line 1 is odd.	3	_____
4. Look up the bout count from the **Round-Robin Bout Counts** table for the estimated fighters and fields.	4	_____
5. Enter the estimated bout time (T_{bout}) in minutes. Use a known time or complete the ***Bout Time Worksheet*** to generate the estimate bout time.	5	_____
6. Multiply line 4 and line 5 and divide by **60**. This is the estimated combat time (T_{combat}) in hours.	6	_____
7. Enter the estimated non-combat time ($T_{non-combat}$) in hours.	7	_____
8. Add line 6 and line 7. This is the estimated tournament time ($T_{tournament}$) in hours.	8	_____

Minimum Bouts: _____ (line 3)

Maximum Bouts: _____ (line 3)

Estimated Combat Time (T_{combat}): _____ (line 6)

Estimated Non-Combat Time ($T_{non-combat}$):_____ (line 7)

Estimated Tournament Time ($T_{tournament}$):_____ (line 8)

Round-Robin Tournament Time Worksheet

1. Enter the estimated number of fighters (n).	1	12
2. Enter the estimated number of fields (f).	2	3
3. Enter the number of rounds (r). 3a. Enter line 1 minus **1** if line 1 is even. 3b. Enter line 1 if line 1 is odd.	3	11
4. Look up the bout count from the **Round-Robin Bout Counts** table for the estimated fighters and fields.	4	22
5. Enter the estimated bout time (T_{bout}) in minutes. Use a known time or complete the ***Bout Time Worksheet*** to generate the estimate bout time.	5	3
6. Multiply line 4 and line 5 and divide by **60**. This is the estimated combat time (T_{combat}) in hours.	6	1.1
7. Enter the estimated non-combat time ($T_{non-combat}$) in hours.	7	0.5
8. Add line 6 and line 7. This is the estimated tournament time ($T_{tournament}$) in hours.	8	1.6

Minimum Bouts: 11 (line 3)

Maximum Bouts: 11 (line 3)

Estimated Combat Time (T_{combat}): 1.1 (line 6)

Estimated Non-Combat Time ($T_{non-combat}$): 0.5 (line 7)

Estimated Tournament Time ($T_{tournament}$): 1.6 (line 8)

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Swiss-System Tournament Time Worksheet

1. Enter the estimated number of fighters (n).	1	_____
2. Enter the estimated number of fields (f).	2	_____
3. Enter the number of rounds (r).	3	_____
4. Look up the bout count from the Swiss-System bout counts table for the estimated fighters, fields, and rounds. 4a. If line 3 equals 5, use the **Swiss-5 Bout Counts** table. 4b. If line 3 equals 8, use the **Swiss-8 Bout Counts** table.	4	_____
5. Enter the estimated bout time (T_{bout}) in minutes. Use a known time or complete the ***Bout Time Worksheet*** to generate the estimate bout time.	5	_____
6. Multiply line 4 and line 5 and divide by **60**. This is the estimated combat time (T_{combat}) in hours.	6	_____
7. Enter the estimated non-combat time ($T_{non-combat}$) in hours.	7	_____
8. Add line 6 and line 7. This is the estimated tournament time ($T_{tournament}$) in hours.	8	_____

Minimum Bouts: _____ (line 3)

Maximum Bouts: _____ (line 3)

Estimated Combat Time (T_{combat}): _____ (line 6)

Estimated Non-Combat Time ($T_{non-combat}$):_____ (line 7)

Estimated Tournament Time ($T_{tournament}$):_____ (line 8)

Bear/Speed Pit Tournament Time Worksheet

Tournament Staff Worksheet

This worksheet estimates the staff required to run a tournament. This worksheets assumes that each field requires 2 field marshals.

1. Enter the number of available fields (f).	1	_____
2. Multiply line 1 by **2**. This is the minimum number of field marshals required.	2	_____
3. Enter the estimated combat time (T_{combat}) in hours.	3	_____
4. Round line 3 to the nearest hour.	4	_____
5. Multiply line 1 and line 4.	5	_____
6. Multiply line 5 by **2**. This is the recommended number of field marshals.	6	_____
7. Is the tournament using field heralds? 7a. Yes. Enter line 1 on line 7. 7b. No. Enter **0** on line 7. This is the required number of field heralds.	7	_____

Minimum Field Marshals: _____ (line 2)

Recommend Field Marshals: _____ (line 6)

Field Heralds: _____ (line 7)

Tournament Staff Worksheet

This worksheet estimates the staff required to run a tournament. This worksheets assumes that each field requires 2 field marshals.

1. Enter the number of available fields (f).	1	3
2. Multiply line 1 by 2: This is the minimum number of field marshals required.	2	6
3. Enter the estimated combat time (T_{combat}) in hours.	3	2.2 hrs
4. Round line 3 to the nearest hour.	4	2 hrs
5. Multiply line 1 and line 4.	5	6
6. Multiply line 5 by 2. This is the recommended number of field marshals.	6	12
7. Is the tournament using field heralds? 7a. Yes. Enter line 1 on line 7. 7b. No. Enter 0 on line 7. This is the required number of field heralds.	7	3

Minimum Field Marshals: 6 (line 2)

Recommend Field Marshals: 12 (line 6)

Field Heralds: 3 (line 7)

Fields: 3
Combat Time: 2.2 hours
Field Heralds!

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Derivation of the Tournament Models

Since the minimum requirement for a successful tournament is the total time, the tournament model will estimate an upper bound on the total time based on the tournament type, tournament rules, number of fighters, and number of available fields. So the goal of of the model is to estimate $T_{tournament}$.

The first step is look at a tournament and see where the time is spent. The table below describes a typical tournament time line based on my experience with tournaments in the western kingdoms (Outlands, Artemisia, and Atenvedlt).

T -45 minutes	Field set up
T -30 minutes	The list opens
T -20 minutes	Armor inspections begin
T -5 minutes	The list closes
T -1 minute	Armor inspections ends
Start Time	Rules of the tournament are announced
T +? minutes	Round #1
T +? minutes	Round #2
T +? minutes	Round #3
T +? minutes	Round #4
	…
T +? minutes	Round #N
T +? minutes	Winner announced
End Time	Field tear down & clean up

Table 1: Tournament Time Line

If the tournament runs on time and on schedule, then the field tear down should occur right at the end time of the tournament. So based on this time line, let's model the tournament time as a sum

of the time for all the non-combat related activities plus the time for the combat.

$$T_{tournament} = T_{non-combat} + T_{combat}$$

Assuming the tournament consists of a set of rounds, the combat time can be modeled as the sum of the time for all the rounds.

$$T_{combat} = \sum_{i=1}^{r} T_{round}$$

$$T_{tournament} = T_{non-combat} + \sum_{i=1}^{r} T_{round}$$

Assuming each round consists of a set of bouts, the round time can be modeled as the number of bouts per round multiplied by the time for each bout. The model assumes the bout time is fixed.

$$T_{round} = T_{bout} N$$

$$T_{tournament} = T_{non-combat} + \sum_{i=1}^{r} T_{bout} N_i$$

$$T_{tournament} = T_{non-combat} + T_{bout} \sum_{i=1}^{r} N_i$$

If the tournament is run on multiple fields, then some of the bouts in the round will be run in parallel and will not contribute to the round. By dividing the bouts per round by the number of fields, the model only takes into consideration are the sequential bouts.

$$T_{tournament} = T_{non-combat} + T_{bout} \sum_{i=1}^{r} \frac{N_i}{f}$$

To enforce the indivisibility of a bout, the ceiling function is applied to the division operation.

$$T_{tournament} = T_{non-combat} + T_{bout} \sum_{i=1}^{r} \lceil \frac{N_i}{f} \rceil$$

Variables

- n : The number of fighters in the list.
- f : The number of fields

T_{fight} : The estimated time for a single fight

α : A scaling factor applied to the single fight time

T_{other} : The estimate time of a bout unrelated to combat

T_{bout} : The estimated time of a bout

The model will use the bout time combined with the bout count in order to estimate the total time for the tournament.

$$T_{bout} = \alpha T_{fight} + T_{other}$$

Rules of the List

The rules of the list are a set of conventions describing how bouts are resolved during the tournament.

Double Kills

Sometimes a fight may end with both opponents striking each other simultaneously for a killing blow. This situation is typically referred to as a “double kill”. Double kills can either result in both fighters taking a loss or be refought until only one fighter is victorious. To avoid double kills resulting an unreasonable number of extra fights, there is usually limit placed on the number of additional fights.

Destructive

Under this tournament rule, a double kill results in a loss for both fighters.

Refought x Times

Under this tournament rule, a double kill is handled through a limited number of additional fights. For example, “Double kills will be refought once.” implies the first double kill will refought. If that fight results in a double kill, both fighters take a loss.

Refought Until Victory

Under this tournament rule, double kills are refought until there is only one victor.

Modeling Double Kills

The effect of the double kill rule on the tournament time is hard to predict. For example, let's assume that double kills result in a loss for both fighters. On the one hand, a loss for both will probably result in a decrease in the total number of bouts fought thus decreasing the tournament time. On the other hand, the harsh consequences may cause some fighters in the tournament to fight more cautiously thus increasing the tournament time.

Conversely, if double kills are handled by a refight, double kills will result in additional fights thus increasing the time of the tournament. And it may cause some fighters to fight more recklessly since the consequences of a double kill are less harsh.

In terms of the tournament model, directly modeling the effect of double kills is difficult as best. While adding additional time to the tournament by computing the probable number fights added because of double is relatively easy, modeling the recklessness factor is not. However, I might not need to model the effect directly since the effect will already be included the empirical time measurements taken from real tournaments. So for the tournament model, I will assume that the empirical time data handles the effect of double kills implicitly for tournaments with a single fight victory condition.

Single Fight vs Best-of-3

A bout may be resolved with a variable number of fights. Typically, a bout consists of a single fight during which one fighter kills or disarms the other fighter to achieve victory. The most of common variation of the bout victory conditions are “Best-of-3” rule. In this variation, the bout continues until one fighter wins or loses the requisite number of fights to satisfy the “best-of-3” requirement depending on the other rules of the list. For the model, a scaling factor will be applied to the bout time T_{bout} to describe the effect of the “best-of-3” rule. The scaling factor is derived by averaging the number of bouts for the “best-of-3” rule [APP].

The table below describes the possible outcomes for a “best-of-3” bout.

Possible Outcomes	**Count**
W-L, W-L	2
W-L, L-W, W-L	3
L-W, W-L, W-L	3
W-L, L-L	2
L-L, W-L	2
L-L, L-L	2

Table 2: Best-of-3 Possible Bout Outcomes

The first 3 outcomes assumes that double kills are refought so the winning fighter must win 2 fights before the losing fighter. The last 3 outcomes assume that double kills are destructive so the losing fighter must lost 2 fights before the winning the fighter. Averaging the possible outcomes gives the model an estimated number of fights per bout which will be used as the scaling factor.

$$\alpha = \frac{(2+3+3)}{3} = 2.7$$

In the case of double kills, the scaling factor is slightly less due to the increased number of shorter bout outcomes.

$$\alpha = \frac{(2+3+3+2+2+2)}{6} = 2.3$$

Since double kills play a significant role in the implementation the “best-of-3” rule, I do model its effect directly through applying a different scaling factor to the fight time.

Byes

In some tournament formats, the scheduling of the bouts can result in a fighter not having an opponent for a given round. This situation is known as a “bye”. A bye can be handle in several different ways but for the purposes of the model, I examine only three ways to handle a bye: skip the round, fight a destructive bout, fight a non-destructive bout.

Skip

Under this rule, the fighter who receives a bye simply skips that round.

Destructive Bout

Under this rule, the fighter who receives a bye must fight a bout against a designated bye fighter and the outcome of the bout is counted.

Non-Destructive Bout

Under this rule, the fighter who receives a bye must fight a bout against a designated bye fighter but the outcome is always considered a win.

In terms of the model, I'm ignoring the destructive bout bye rule since I'm only looking for an upper bound on the tournament time and the tournament time under the destructive bout rule will always be less than or equal to the tournament time under the non-destructive bout rule. Thus the tournament model will only use the non-destructive bout and skip bye rules.

Non-Combat Time Estimates

Heraldry

Heraldry during a bout can be handled by the field marshals or a field herald. The Outlands herald's handbook contains a detailed section on field heraldry which is what I use here to estimate some of the non-combat time during a bout.

“Fighter X and Fighter Y arm and take the field!”

“Fighter A and Fighter B make ready!”

“Fighter C and Fighter D, prepare!”

“On this field of combat, Fighter X faces Fighter Y!”

Formal Salutes

“Fighters, salute the Crown of the Outlands.”

“Fighters, salute the Baron & Baroness.”

“Salute the one whose favor you bear.”

“Salute your most worthy opponent.”

“And pray heed the word of the marshals.”

“Fighter X, are you prepared?”

“Fighter Y, are you prepared?”

Informal Salutes

“Fighters, make all appropriate salutes.”

“Fighter X, are you prepared?”

“Fighter Y, are you prepared?”

Satisfaction

“Fighter X, are you satisfied?”

“Fighter Y, are you “satisfied?”

“Victory to Fighter X!”

Tournament Formats

Elimination Tournaments

In an elimination tournament, fighters are paired of into a bouts to form a round. At the end of each round, losing fighters are eliminated from the tournament and remaining fighters are again paired into bouts. The tournament continues until only one fighter remains.

Elimination tournaments are a very popular tournament format because they can be run quickly and the fighters in the tournament get high visibility. However, elimination tournaments require

careful seeding to avoid strong biases and the majority of fighters in the tournament only fight a couple of bouts.

Multiple Fields

As the number of fighters decreases in an elimination tournament, the number of bouts may drop below the number of available fields. Most tournaments switch to a single field at this point although tournaments under time pressure may continue to utilize multiple fields.

Modeling an Elimination Tournament

Elimination tournaments are difficult to model due to the dependency of each round on the outcome of the bouts in the previous round. From the tournament model, the combat time is the sum of the bouts per round divided by the number of fields and multiplied by the bout time.

$$T_{combat} = T_{bout} \sum_{i=1}^{r} \lceil \frac{N_i}{f} \rceil$$

The next step is to compute the number of bouts per round N_i for a given elimination tournament. I started with a single elimination tournament with 8 fighters.

Round	**Bouts**	**Bouts per Round (N_i)**
1	1-2, 3-4, 5-6, 7-8	4
2	1-3, 5-7	2
3	1-5	1
	Total	7

Table 3: Round Layout, Single Elimination, n = 8 fighters

Next the number of fighters is increased to 9.

Round	**Bouts**	**Bouts Per Round (N_i)**
1	1-2, 3-4, 5-6, 7-8, 9-Bye	4
2	1-3, 5-9, 7-Bye	2
3	1-7, 5-Bye	1
4	1-5	1
	Total	8

Table 4: Round Layout, Single Elimination, n = 9 fighters, Skip Bye

If the byes are resolved through a bout, the model must include them in the bouts per round to avoid underestimating the round time.

Round	Bouts	Bouts Per Round (N_i)
1	1-2, 3-4, 5-6, 7-8, 9-Bye	5
2	1-3, 5-9, 7-Bye	3
3	1-7, 5-Bye	2
4	1-5	1
	Total	11

Table 5: Round Layout, Single Elimination, n = 9 fighters, Bout Bye

So for a single elimination tournament, the bouts per round (N_i), can be computed using the following expression:

$$N_i = \lceil \frac{n}{2^i} \rceil$$

where n is the number of fighters and i is the round.

Since the tournament model is only looking for an upper bound on the tournament time, the model will assume that byes are handle through a non-destructive bout. The other two bye rules will always result in a tournament time less than or equal to the non-destructive bout bye rule.

Unfortunately, there is no simple way to compute the bouts per round for an elimination tournament consisting of n fighters run on f fields [APP]. Rather than attempt to compute a closed-form solution to the problem, I decided to use Monte Carlo simulation to determine the bouts per round. I implemented a tournament simulator in C# and had it run thousands of virtual tournaments. From the virtual tournament data, I was able to data mine the maximum number of bouts, $\sum_{i=1}^{r} \lceil \frac{N_i}{f} \rceil$, for each permutation of fighters and fields. The collated results of the simulation runs are listed in the appendices.

Group Tournaments

In a group tournament, all fighters compete in a fixed number of rounds and the fighter with the most victories is the winner.

Group tournaments have a number of advantages over the elimination tournaments. Since there's no elimination, every fighter in the tournament fights the same number of rounds (not accounting for ties) and the minimum number of bouts is significantly higher than in the elimination

tournaments.

The primary disadvantage of the group tournament is the scalability. These types of tournaments work best with a relatively small number of fighters. Another disadvantage of the group tournaments is the possibility of ties. Unlike the elimination tournaments, group tournaments are scored and the highest score determines the victor. Depending on the outcome of the bouts and the tournament rules, several fighters could achieve the same score.

Round-Robin

In a round-robin tournament, each fighter competes in single bout with every other fighter in the tournament. Counting the total number of bouts is relatively easy.

$$\sum_{i=1}^{r} N_i = \frac{n(n-1)}{2}$$

While the total number bouts is always the same for a round robin tournament, the mapping of the bouts into rounds depends on the whether or not the number of fighters is even. For an even number of fighters, every fighter is assigned to a bout in the round.

$$\sum_{i=1}^{r} N_i = \sum_{i=1}^{n-1} \frac{n}{2} = (n-1)\frac{n}{2}$$

Accounting for multiple fields yields

$$\sum_{i=1}^{r} \lceil \frac{N_i}{f} \rceil = \sum_{i=1}^{n-1} \lceil \frac{n}{2f} \rceil = (n-1)\lceil \frac{n}{2f} \rceil$$

In the case of an odd number of fighters, the bye is always skipped and an extra round is fought to account for the byes. Accounting for multiple fields yields

$$\sum_{i=1}^{r} \lceil \frac{N_i}{f} \rceil = \sum_{i=1}^{n} \lceil \frac{(n-1)}{2f} \rceil = n\lceil \frac{(n-1)}{2f} \rceil$$

Thus the combat time can be modeled as

$$T_{combat} = T_{bout} \sum_{i=1}^{r} \lceil \frac{N_i}{f} \rceil = \begin{cases} T_{bout}(n-1)\lceil \frac{n}{2f} \rceil & n \text{ is even} \\ T_{bout} n \lceil \frac{(n-1)}{2f} \rceil & n \text{ is odd} \end{cases}$$

and the rounds as

$$r=\begin{cases}(n-1) & n \text{ is even} \\ n & n \text{ is odd}\end{cases}$$

Since there's no elimination in this tournament format, all fighters fight the same number of bouts.

$$\text{Minimum Bouts} = \text{Maximum Bouts} = (n-1)$$

Swiss-System

A Swiss-system tournament takes a round-robin tournament and limits the number of rounds. The most common format for SCA rapier is the Swiss 5 where each round uses a different weapon style (single rapier, rapier & buckler, rapier & cloak, rapier & dagger, and dual rapiers).

The limiting of the number of rounds greatly decreases the length of the tournament but still allows every fighter to fight a significant number of bouts.

$$\sum_{i=1}^{r} N_i = \frac{rn}{2}$$

Unlike a round-robin tournament, byes in a Swiss tournament are typically handled with a bout to avoid issues with fairness and scheduling.

Thus if n is even,

$$\sum_{i=1}^{r} \lceil \frac{N_i}{f} \rceil = r \lceil \frac{n}{2f} \rceil$$

else if n is odd,

$$\sum_{i=1}^{r} \lceil \frac{N_i}{f} \rceil = r \lceil \frac{(n+1)}{2f} \rceil$$

Thus the combat time can be modeled as

$$T_{combat} = T_{bout} \sum_{i=1}^{r} \lceil \frac{N_i}{f} \rceil = \begin{cases} T_{bout} r \lceil \frac{n}{2f} \rceil & n \text{ is even} \\ T_{bout} r \lceil \frac{(n+1)}{2f} \rceil & n \text{ is odd} \end{cases}$$

Since there's no elimination in this tournament format, all fighters fight the same number of bouts.

$$\text{Minimum Bouts} = \text{Maximum Bouts} = r$$

Timed Tournaments

In a timed tournament, fighters attempt to compete in as many bouts as possible within a given time frame. The overall victor of a timed tournament is the fighter with the greatest number of victorious bouts. In the model, the total time for the pit is defined as T_{pit} .

A timed tournament offers several advantages over the elimination and group tournament formats. First, the total time to run the tournament can easily be estimated without knowing the number of fighters entering the tournament which allows for easier scheduling. Second, a fighter can easily enter, exit, or reenter the tournament at any point during tournament. Finally, timed tournaments allow fighters to compete in a larger number of bouts than elimination tournaments while avoiding the long delay between bouts inherent to group tournaments.

The primary disadvantage of timed tournaments is the lack of visibility. Since timed tournaments don't have prepared rounds, fighters in the bouts are rarely announced to the spectators and in order to simplify the tracking of the tournament progressions, fighters are often referred to by number rather than name.

While the number of fields does not affect the time of the tournament, it does decrease the time between bouts and increase the minimum number of bouts.

Open Challenge

In an open challenge tournament, the fighters in the list challenge each other to bouts until the time runs out. This type of tournament often employs some form of scoring system so the overall victor is the fighter who scores the most points.

$$T_{combat} = T_{pit}$$

Since there aren't scheduled bouts, the minimum and maximum number of bouts is up the individual fighters. Thus the minimum number of bouts is

$$\text{Minimum Bouts} = 1$$

and the maximum number of bouts is possible number of bouts

$$\text{Maximum Bouts} = \frac{T_{pit}}{T_{bout}}$$

Bear Pit

In a bear pit, the fighters are lined up next to the field entrance. At the start of the tournament, first two fighters in line take the field and the bout starts. At the end of the bout, the losing fighter leaves the field and the next fighter in line takes the field against the winning fighter. The

losing fighter joins the end of the line and the tournament continues until the time runs out.

$$T_{combat} = T_{pit}$$

The key to a successful bear pit is determining the optimal time between bouts for a losing fighter. If the time between bouts is too long, then fighters will spend most of the tournament standing in line. If the time between bouts is too short, then fighters will not get a chance to recover between bouts.

To derive an estimate for the time between bouts for a bear pit with n fighters and running on f fields, I model the tournament as queue. The time between bouts is simply a measure of the number of bouts that occur before a given fighter returns to the field. I assume that each bout takes the same finite time and each bout starts and ends at the same time on all fields. The tables below illustrate the discrete simulation of queue in execution with 12 fighters.

Field #1	**Line**
1-2	3,4,5,6,7,8,9,10,11,12
1-3	4,5,6,7,8,9,10,11,12,2
1-4	5,6,7,8,9,10,11,12,2,3
1-5	6,7,8,9,10,11,12,2,3,4
1-6	7,8,9,10,11,12,2,3,4,5
1-7	8,9,10,11,12,2,3,4,5
1-8	9,10,11,12,2,3,4,5,6
1-9	10,11,12,2,3,4,5,6,7
1-10	11,12,2,3,4,5,6,7,8
1-11	12,2,3,4,5,6,7,8,9,10
1-12	2,3,4,5,6,7,8,9,10,11
1-2	3,4,5,6,7,8,9,10,11,12

Table 6: Bear Pit, n = 12 fighters, f = 1 field

Field #1	Field #2	Line
1-2	3-4	5,6,7,8,9,10,11,12
1-5	3-6	7,8,9,10,11,12,2,4
1-7	3-8	9,10,11,12,2,4,5,6
1-9	3-10	11,12,2,4,5,6,7,8
1-11	3-12	2,4,5,6,7,8,9,10
1-2	3-4	5,6,7,8,9,10,11,12

Table 7: Bear Pit, n = 12 fighters, f = 2 fields

Field #1	Field #2	Field #3	Line
1-2	3-4	5-6	7,8,9,10,11,12
1-7	3-8	5-9	10,11,12,2,4,6
1-10	3-11	5-12	2,4,6,7,8,9
1-2	3-4	5-6	7,8,9,10,11,12

Table 8: Bear Pit, n = 12 fighters, f = 3 fields

Field #1	Field #2	Field #3	Field #4	Line
1-2	3-4	5-6	7-8	9,10,11,12
1-9	3-10	5-11	7-12	2,4,6,8
1-2	3-4	5-6	7-8	9,10,11,12

Table 9: Bear Pit, n = 12 fighters, f = 4 fields

The number of intervening bouts is summarized in the table below.

f	Bouts
1	10
2	4
3	2
4	1

Table 10: Bear Pit, Bouts per Field

In equation form, the number of intervening bouts is the number of fighters ahead of a given

fighter divided by the number of fields.

$$N_{between} = \frac{n-2f}{f}$$

The time between bouts is the bout time multiplied by the number of intervening bouts.

$$T_{between} = T_{bout} N_{between} = T_{bout} \left(\frac{n-2f}{f} \right)$$

Using the time between bouts, the minimum number of bouts can computed as

$$\text{Minimum Bouts} = \frac{T_{pit}}{T_{bout} \left(\frac{n-2f}{f} \right)}$$

and the maximum number of bouts as

$$\text{Maximum Bouts} = \frac{T_{pit}}{T_{bout}}$$

Let's use the time between bouts to examine the relationship between the size of the list and the number of fighters. In the table below, the T_{bout} is assumed to be 30 seconds.

n	**1**	**2**	**3**	**4**	**5**	**6**
8	3	1	0.3	0	0	0
16	7	3	1.7	1	0.3	0
24	11	5	3	2	1	0.5
32	15	7	4.3	3	1.7	1
48	23	11	7	5	3	2
64	31	15	9.7	7	4.3	3
96	47	23	15	11	7	5
128	63	31	20.3	15	9.7	7

Table 11: Time Between Bouts in Minutes, Bout Time = 30s

The time between bouts equation can be used to determine lower bound for the number of fighters for a given number of fields by letting the time between bouts go to T_{bout} .

$$T_{between} = T_{bout}\left(\frac{n-2f}{f}\right)$$

$$T_{bout} = T_{bout}\left(\frac{n-2f}{f}\right)$$

$$f = (n-2f)$$

$$n_{min} = 3f$$

Thus, a bear pit running on f fields needs at least $3f$ fighters in order to give each fighter at least T_{bout} downtime between fights.

Let's assume the bear pit is run on 3 fields for 9 fighters.

Field #1	**Field #2**	**Field #3**	**Line**
1-2	3-4	5-6	7,8,9
1-7	3-8	5-9	2,4,6
1-2	3-4	5-6	7,8,9

Table 12: Bear Pit, n =9 fighters, f = 3 fields

If the number of fighters drops below $3f$, then one fighter immediately returns to the field with no downtime between fights.

Field #1	**Field #2**	**Field #3**	**Line**
1-2	3-4	5-6	7,8
1-7	3-8	5-2	4,6
1-4	3-6	5-7	8,2

Table 13: Bear Pit, n = 8 fighters, f = 3 fields

The upper bound on the number of fighters for a given number of fields is derived from the time between bouts. If a fighter completes one bout and the time between bouts is equal to the pit time minus one bout time, then the fighter will not be able to return to the field before the tournament runs out of time.

$$T_{between} = T_{bout}\left(\frac{n-2f}{f}\right)$$

$$T_{pit} - T_{bout} = T_{bout}\left(\frac{n-2f}{f}\right)$$

$$\frac{T_{pit} - T_{bout}}{T_{bout}} = \frac{n-2f}{f}$$

$$\frac{T_{pit}}{T_{bout}} - 1 = \frac{n-2f}{f}$$

$$f\left(\frac{T_{pit}}{T_{bout}} - 1\right) = n - 2f$$

$$n = f\left(\frac{T_{pit}}{T_{bout}} - 1\right) + 2f$$

$$n_{max} = f\left(\frac{T_{pit}}{T_{bout}} + 1\right)$$

Let's assume the pit time is 5 minutes on a single field with 1 minute per bout. The maximum number of fighters is 6. The last bout doesn't run because the tournament time runs out at the end of the previous bout.

Field #1	**Line**	**Time**
1-2	3,4,5,6	0:00
1-3	4,5,6,2	1:00
1-4	5,7,2,3	2:00
1-5	7,2,3,4	3:00
1-6	2,3,4,5	4:00
1-2	3,4,5,6	5:00

Table 14: Bear Pit, f = 1 field

Let's assume the pit time is 5 minutes on two fields with 1 minute per bout. The maximum number of fighters is 12. The last two bouts don't run because the tournament time runs out at the end of the previous bout.

Field #1	Field #2	Line	Time
1-2	3-4	5,6,7,8,9,10,11,12	0:00
1-5	3-6	7,8,9,10,11,12,2,4	1:00
1-7	3-8	9,10,11,12,2,4,5,6	2:00
1-9	3-10	11,12,2,4,5,6,7,8	3:00
1-11	3-12	2,4,5,6,7,8,9,10	4:00
1-2	3-4	5,6,7,8,9,10,11	5:00

Table 15: Bear Pit, f = 2 fields

Thus the number of fighters for a bear pit is defined by the relationship

$$3f \le n \le f\left(\frac{T_{pit}}{T_{bout}} + 1\right)$$

By solving the time between equation for the maximum number of fighters for the number of fields f, we can compute the minimum number of fields.

$$f_{min} = \frac{n}{\left(\frac{T_{pit}}{T_{bout}} + 1\right)}$$

Speed Pit

A speed pit is a bear pit in which each bout has a maximum duration. At the start of the bout, the field marshals start the timer and if combat is not resolved before the time runs out, both fighters take a loss and leave the field.

The advantage of the speed pit over the bear pit is that it maximizes the number of bouts fought during the tournament and prevents fighters from “stalling” to gain strategic advantage.

Multistage Tournaments

A multistage tournament is composed of two or more sub-tournaments with a limited number of fighters progressing to each subsequent sub-tournament. Usually a multistage tournaments consist of a group or timed tournament followed by an elimination tournament to determine the overall winner. Multistage tournaments are typically used to increase the visibility of timed tournaments or shorten the duration of very large group tournaments.

Multistage tournaments will use multiple fields for the group or timed portion of the tournament but almost always use a single field for the elimination portion of the tournament.

Bear Pit with Top *m*

In this multistage tournament, the top *m* scoring fighters from the bear pit then compete in a set of ladder elimination bouts to determine the overall victor.

Bouts: $\frac{T_{pit} f}{T_{bout}} + (m_{top} - 2)$

Time: $T_{pit} + T_{bout}(m_{top} - 2)$

Time Between Bouts: $T_{bout}\left(\frac{n-2f}{f}\right)$

Minimum Bouts: $\frac{T_{pit}}{T_{bout}\left(\frac{n-2f}{f}\right)}$

Maximum Bouts: $\frac{T_{pit}}{T_{bout}}$

Bear Pit Quarters with Single Elimination

In this multistage tournament, the bear pit tournament is paused at each quarter time interval and *m* fighters with the highest scores are removed from the bear pit and entered the single elimination tournament. The single elimination tournament then determines the overall victor.

Bouts: $\frac{T_{pit} f}{T_{bout}} + (4 m_{top} - 1)$

Time: $T_{pit} + T_{bout}(4 m_{top} - 1)$

Time Between Bouts: $T_{bout}(\frac{n-2f}{f})$

Minimum Bouts: $\frac{T_{pit}}{T_{bout}(\frac{n-2f}{f})}$

Maximum Bouts: $\frac{T_{pit}}{T_{bout}}$

Pooled Round-Robin with Single Elimination

In this multistage tournament, the list is broken up into a set of smaller lists referred to as pools based on the number of available fields. The pools are then run as round-robin tournaments with the top *m* fighters from each pool advancing the single elimination tournament which determines

the overall victor.

With the pools running simultaneously, the time for the round-robin portion of the tournament is simply the amount of time need to run a round-robin with $\frac{n}{f}$ fighters.

Bouts: $\frac{(\frac{n}{f})(\frac{n}{f}-1)}{2}+(m_{top}f-1)$

Time: $T_{bout}(\frac{(\frac{n}{f})(\frac{n}{f}-1)}{2}+(m_{top}f-1))$

Minimum Bouts: $(\frac{n}{f}-1)$

Maximum Bouts: $(\frac{n}{f}-1)+\log_2(m_{top}f)$

Appendix – Single Elimination Bout Counts

Fighters	Rounds	1 Field	2 Fields	3 Fields	4 Fields	5 Fields	6 Fields	7 Fields	8 Fields
8	3	7	4	4	3	3	3	3	3
9	4	11	7	5	5	4	4	4	4
10	4	11	7	5	5	4	4	4	4
11	4	12	7	5	5	5	4	4	4
12	4	12	7	5	5	5	4	4	4
13	4	14	8	7	5	5	5	4	4
14	4	14	8	7	5	5	5	4	4
15	4	15	8	7	5	5	5	5	4
16	4	15	8	7	5	5	5	5	4
17	5	20	12	8	8	6	6	6	6
18	5	20	12	8	8	6	6	6	6
19	5	21	12	9	8	6	6	6	6
20	5	21	12	9	8	6	6	6	6
21	5	23	13	9	8	8	6	6	6
22	5	23	13	9	8	8	6	6	6
23	5	24	13	9	8	8	6	6	6
24	5	24	13	9	8	8	6	6	6
25	5	27	15	12	9	8	8	6	6
26	5	27	15	12	9	8	8	6	6
27	5	28	15	12	9	8	8	6	6
28	5	28	15	12	9	8	8	6	6
29	5	30	16	12	9	8	8	8	6
30	5	30	16	12	9	8	8	8	6
31	5	31	16	13	9	9	8	8	6
32	5	31	16	13	9	9	8	8	6
33	6	37	21	14	13	10	9	9	9
34	6	37	21	14	13	10	9	9	9
35	6	38	21	14	13	10	9	9	9
36	6	38	21	14	13	10	9	9	9

37	6	40	22	16	13	10	10	9	9
38	6	40	22	16	13	10	10	9	9
39	6	41	22	16	13	10	10	9	9
40	6	41	22	16	13	10	10	9	9
41	6	44	24	16	14	13	10	9	9
42	6	44	24	16	14	13	10	9	9
43	6	45	24	17	14	13	10	10	9
44	6	45	24	17	14	13	10	10	9
45	6	47	25	17	14	13	10	10	9
46	6	47	25	17	14	13	10	10	9
47	6	48	25	17	14	13	10	10	9
48	6	48	25	17	14	13	10	10	9
49	6	52	28	21	16	13	13	10	10
50	6	52	28	21	16	13	13	10	10
51	6	53	28	21	16	14	13	10	10
52	6	53	28	21	16	14	13	10	10
53	6	55	29	21	16	14	13	10	10
54	6	55	29	21	16	14	13	10	10
55	6	56	29	22	16	14	13	10	10
56	6	56	29	22	16	14	13	10	10
57	6	59	31	22	17	14	13	13	10
58	6	59	31	22	17	14	13	13	10
59	6	60	31	22	17	14	13	13	10
60	6	60	31	22	17	14	13	13	10
61	6	62	32	24	17	16	14	13	10
62	6	62	32	24	17	16	14	13	10
63	6	63	32	24	17	16	14	13	10
64	6	63	32	24	17	16	14	13	10
65	7	70	38	25	22	17	15	14	14
66	7	70	38	25	22	17	15	14	14
67	7	71	38	26	22	17	15	14	14
68	7	71	38	26	22	17	15	14	14

69	7	73	39	26	22	17	15	14	14
70	7	73	39	26	22	17	15	14	14
71	7	74	39	26	22	18	15	15	14
72	7	74	39	26	22	18	15	15	14
73	7	77	41	29	23	18	17	15	14
74	7	77	41	29	23	18	17	15	14
75	7	78	41	29	23	18	17	15	14
76	7	78	41	29	23	18	17	15	14
77	7	80	42	29	23	18	17	15	14
78	7	80	42	29	23	18	17	15	14
79	7	81	42	30	23	18	17	15	14
80	7	81	42	30	23	18	17	15	14
81	7	85	45	30	25	22	17	15	15
82	7	85	45	30	25	22	17	15	15
83	7	86	45	30	25	22	17	15	15
84	7	86	45	30	25	22	17	15	15
85	7	88	46	32	25	22	18	17	15
86	7	88	46	32	25	22	18	17	15
87	7	89	46	32	25	22	18	17	15
88	7	89	46	32	25	22	18	17	15
89	7	92	48	32	26	22	18	17	15
90	7	92	48	32	26	22	18	17	15
91	7	93	48	33	26	23	18	17	15
92	7	93	48	33	26	23	18	17	15
93	7	95	49	33	26	23	18	17	15
94	7	95	49	33	26	23	18	17	15
95	7	96	49	33	26	23	18	17	15
96	7	96	49	33	26	23	18	17	15
97	7	101	53	38	29	23	22	17	17
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99	7	102	53	38	29	23	22	18	17
100	7	102	53	38	29	23	22	18	17

101	7	104	54	38	29	25	22	18	17
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104	7	105	54	39	29	25	22	18	17
105	7	108	56	39	30	25	22	18	17
106	7	108	56	39	30	25	22	18	17
107	7	109	56	39	30	25	22	18	17
108	7	109	56	39	30	25	22	18	17
109	7	111	57	41	30	25	23	18	17
110	7	111	57	41	30	25	23	18	17
111	7	112	57	41	30	26	23	18	17
112	7	112	57	41	30	26	23	18	17
113	7	116	60	41	32	26	23	22	18
114	7	116	60	41	32	26	23	22	18
115	7	117	60	42	32	26	23	22	18
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125	7	126	64	45	33	29	25	22	18
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128	7	127	64	46	33	29	25	23	18
129	8	135	71	47	39	30	26	24	23
130	8	135	71	47	39	30	26	24	23
131	8	136	71	47	39	31	26	24	23
132	8	136	71	47	39	31	26	24	23

133	8	138	72	49	39	31	27	24	23
134	8	138	72	49	39	31	27	24	23
135	8	139	72	49	39	31	27	24	23
136	8	139	72	49	39	31	27	24	23
137	8	142	74	49	40	31	27	24	23
138	8	142	74	49	40	31	27	24	23
139	8	143	74	50	40	31	27	24	23
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143	8	146	75	50	40	33	27	26	23
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145	8	150	78	54	42	33	30	26	24
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147	8	151	78	54	42	33	30	26	24
148	8	151	78	54	42	33	30	26	24
149	8	153	79	54	42	33	30	26	24
150	8	153	79	54	42	33	30	26	24
151	8	154	79	55	42	34	30	26	24
152	8	154	79	55	42	34	30	26	24
153	8	157	81	55	43	34	30	26	24
154	8	157	81	55	43	34	30	26	24
155	8	158	81	55	43	34	30	27	24
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157	8	160	82	57	43	34	31	27	24
158	8	160	82	57	43	34	31	27	24
159	8	161	82	57	43	34	31	27	24
160	8	161	82	57	43	34	31	27	24
161	8	166	86	57	46	39	31	27	26
162	8	166	86	57	46	39	31	27	26
163	8	167	86	58	46	39	31	27	26
164	8	167	86	58	46	39	31	27	26

165	8	169	87	58	46	39	31	27	26
166	8	169	87	58	46	39	31	27	26
167	8	170	87	58	46	39	31	27	26
168	8	170	87	58	46	39	31	27	26
169	8	173	89	61	47	39	33	30	26
170	8	173	89	61	47	39	33	30	26
171	8	174	89	61	47	40	33	30	26
172	8	174	89	61	47	40	33	30	26
173	8	176	90	61	47	40	33	30	26
174	8	176	90	61	47	40	33	30	26
175	8	177	90	62	47	40	33	30	26
176	8	177	90	62	47	40	33	30	26
177	8	181	93	62	49	40	33	30	27
178	8	181	93	62	49	40	33	30	27
179	8	182	93	62	49	40	33	30	27
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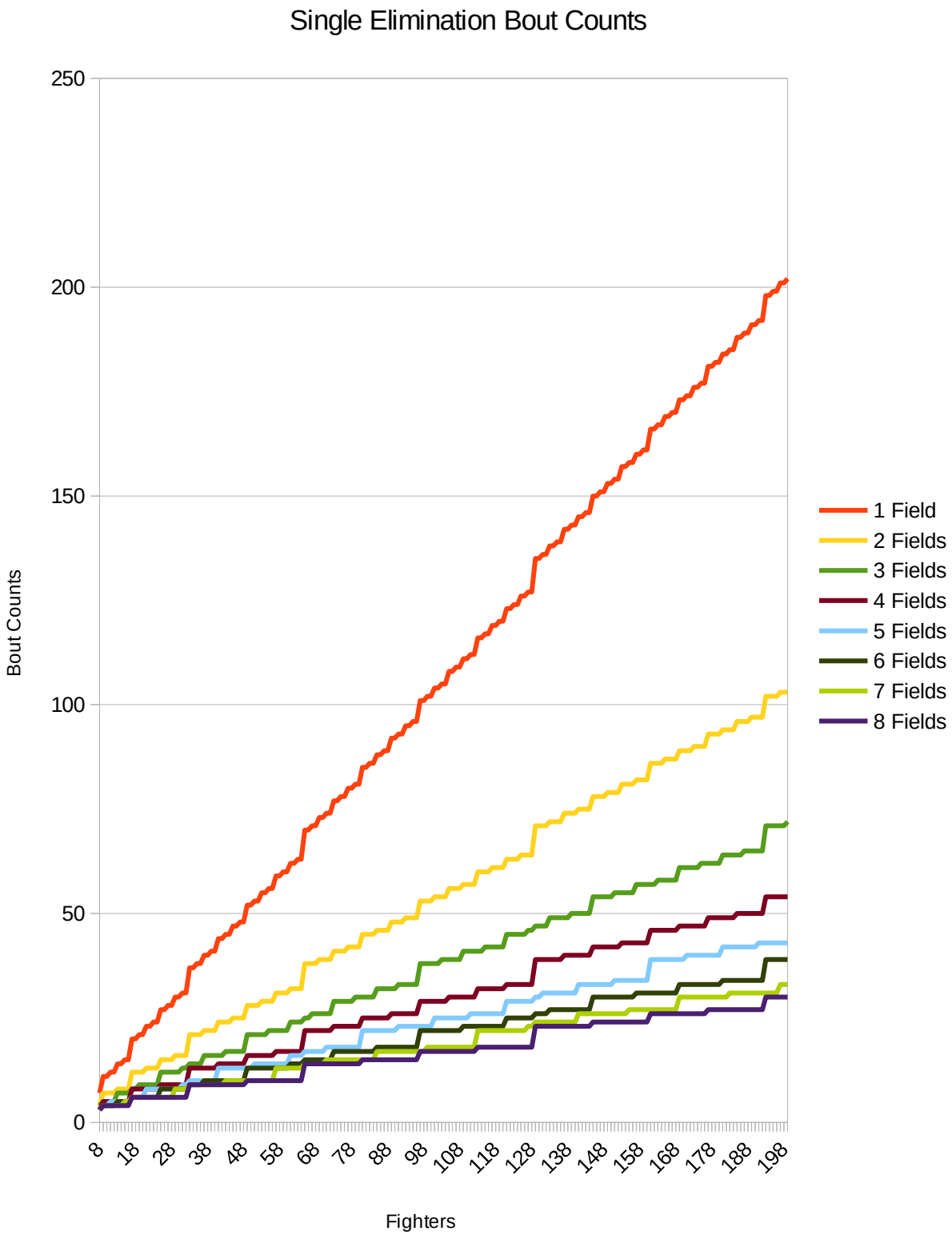
181	8	184	94	64	49	42	34	30	27
182	8	184	94	64	49	42	34	30	27
183	8	185	94	64	49	42	34	31	27
184	8	185	94	64	49	42	34	31	27
185	8	188	96	64	50	42	34	31	27
186	8	188	96	64	50	42	34	31	27
187	8	189	96	65	50	42	34	31	27
188	8	189	96	65	50	42	34	31	27
189	8	191	97	65	50	42	34	31	27
190	8	191	97	65	50	42	34	31	27
191	8	192	97	65	50	43	34	31	27
192	8	192	97	65	50	43	34	31	27
193	8	198	102	71	54	43	39	31	30
194	8	198	102	71	54	43	39	31	30
195	8	199	102	71	54	43	39	31	30
196	8	199	102	71	54	43	39	31	30

197	8	201	103	71	54	43	39	33	30
198	8	201	103	71	54	43	39	33	30
199	8	202	103	72	54	43	39	33	30

Table 16: Single Elimination Bout Counts


Single Elimination Bout Counts
250
200
150
100
50
0
Bout Counts
8
18
28
38
48
58
68
78
88
98
108
118
128
138
148
158
168
178
188
198
Fighters
1 Field
2 Fields
3 Fields
4 Fields
5 Fields
6 Fields
7 Fields
8 Fields

Appendix – Double Elimination Bout Counts

Fighters	Rounds	1 Field	2 Fields	3 Fields	4 Fields	5 Fields	6 Fields	7 Fields	8 Fields
8	6	16	9	8	6	6	6	6	6
9	7	22	13	10	9	7	7	7	7
10	7	22	13	10	9	7	7	7	7
11	7	27	15	11	10	9	7	7	7
12	7	27	15	11	10	9	7	7	7
13	8	32	18	14	11	11	10	8	8
14	8	32	18	14	11	11	10	8	8
15	8	34	18	14	11	11	10	10	8
16	8	34	18	14	11	11	10	10	8
17	8	40	23	16	14	11	11	10	10
18	8	40	23	16	14	11	11	10	10
19	8	44	23	18	14	12	11	11	10
20	8	44	23	18	14	12	11	11	10
21	9	49	27	19	16	15	12	12	12
22	9	49	27	19	16	15	12	12	12
23	9	51	27	19	16	15	12	12	12
24	9	51	27	19	16	15	12	12	12
25	9	56	31	23	19	15	15	12	12
26	9	56	31	23	19	15	15	12	12
27	9	60	32	23	19	16	15	13	12
28	9	60	32	23	19	16	15	13	12
29	9	63	34	23	19	16	15	15	12
30	9	63	34	23	19	16	15	15	12
31	9	65	34	25	19	18	15	15	12
32	9	65	34	25	19	18	15	15	12
33	10	74	40	28	24	20	17	16	16
34	10	74	40	28	24	20	17	16	16
35	10	77	40	28	24	20	17	16	16
36	10	77	40	28	24	20	17	16	16

37	10	81	43	31	24	20	19	17	16
38	10	81	43	31	24	20	19	17	16
39	10	83	43	31	24	20	19	17	16
40	10	83	43	31	24	20	19	17	16
41	10	89	48	33	27	24	20	17	16
42	10	89	48	33	27	24	20	17	16
43	10	94	49	35	28	24	20	20	17
44	10	94	49	35	28	24	20	20	17
45	10	97	51	35	28	24	20	20	17
46	10	97	51	35	28	24	20	20	17
47	10	99	51	35	28	24	20	20	17
48	10	99	51	35	28	24	20	20	17
49	10	105	56	39	32	25	24	20	20
50	10	105	56	39	32	25	24	20	20
51	10	109	56	39	32	27	24	20	20
52	10	109	56	39	32	27	24	20	20
53	10	114	60	40	33	28	24	20	20
54	10	114	60	40	33	28	24	20	20
55	10	116	60	42	33	28	24	20	20
56	10	116	60	42	33	28	24	20	20
57	10	121	63	44	35	28	24	24	20
58	10	121	63	44	35	28	24	24	20
59	10	125	64	45	35	29	24	24	20
60	10	125	64	45	35	29	24	24	20
61	10	128	66	47	35	31	26	24	20
62	10	128	66	47	35	31	26	24	20
63	10	130	66	47	35	31	26	24	20
64	10	130	66	47	35	31	26	24	20
65	11	138	74	50	41	33	29	25	25
66	11	139	74	50	41	33	29	25	25
67	11	142	74	52	41	34	29	25	25
68	11	142	74	52	41	34	29	25	25

69	11	145	77	52	41	34	29	25	25
70	11	146	77	52	41	34	29	25	25
71	11	148	77	52	41	36	29	27	25
72	11	148	77	52	41	36	29	27	25
73	11	154	80	56	43	36	32	28	25
74	11	154	80	56	43	36	32	28	25
75	11	159	82	57	45	36	33	29	25
76	11	159	82	57	45	36	33	29	25
77	11	162	84	57	45	36	33	29	25
78	11	162	84	57	45	36	33	29	25
79	11	164	84	59	45	36	33	29	25
80	11	164	84	59	45	36	33	29	25
81	11	170	89	60	49	40	34	29	28
82	11	170	89	60	49	40	34	29	28
83	11	174	89	61	49	40	34	30	28
84	11	174	89	61	49	40	34	30	28
85	11	178	92	63	50	41	36	32	29
86	11	178	92	63	50	41	36	32	29
87	11	180	92	63	50	41	36	32	29
88	11	180	92	63	50	41	36	32	29
89	11	185	96	64	52	41	36	33	29
90	11	185	96	64	52	41	36	33	29
91	11	189	97	66	52	43	36	33	29
92	11	189	97	66	52	43	36	33	29
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97	11	202	104	73	56	45	40	34	32
98	11	202	104	73	56	45	40	34	32
99	11	206	104	73	56	46	40	36	32
100	11	206	104	73	56	46	40	36	32

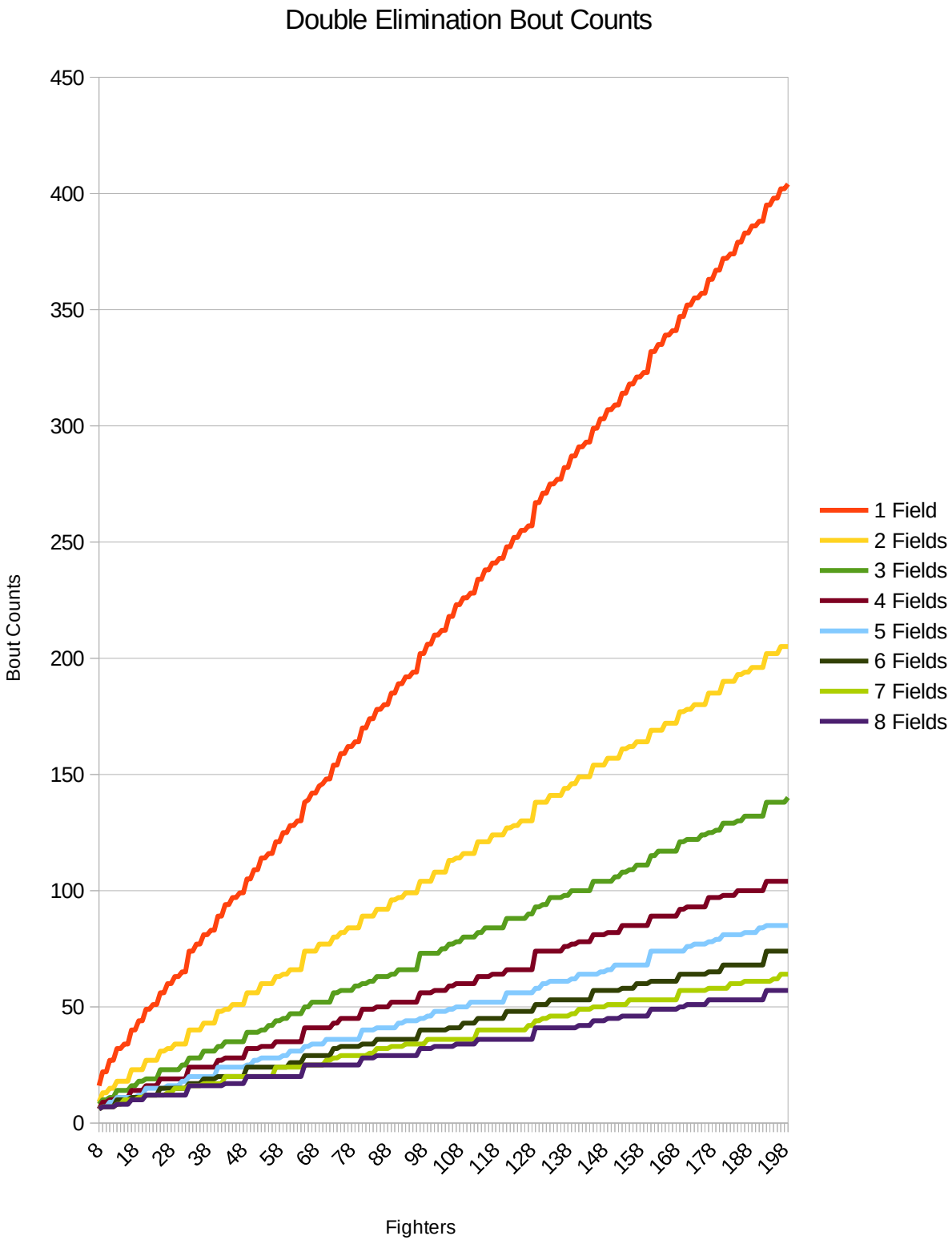
101	11	210	108	73	57	48	40	36	33
102	11	210	108	73	57	48	40	36	33
103	11	212	108	75	57	48	40	36	33
104	11	212	108	75	57	48	40	36	33
105	11	218	113	77	59	49	41	36	33
106	11	218	113	77	59	49	41	36	33
107	11	223	114	78	60	50	41	36	34
108	11	223	114	78	60	50	41	36	34
109	11	226	116	80	60	50	43	36	34
110	11	226	116	80	60	50	43	36	34
111	11	228	116	80	60	52	43	36	34
112	11	228	116	80	60	52	43	36	34
113	11	234	121	82	63	52	45	40	36
114	11	234	121	82	63	52	45	40	36
115	11	238	121	84	63	52	45	40	36
116	11	238	121	84	63	52	45	40	36
117	11	241	124	84	64	52	45	40	36
118	11	241	124	84	64	52	45	40	36
119	11	243	124	84	64	52	45	40	36
120	11	243	124	84	64	52	45	40	36
121	11	248	127	88	66	56	48	40	36
122	11	248	127	88	66	56	48	40	36
123	11	252	128	88	66	56	48	40	36
124	11	252	128	88	66	56	48	40	36
125	11	255	130	88	66	56	48	40	36
126	11	255	130	88	66	56	48	40	36
127	11	257	130	90	66	56	48	42	36
128	11	257	130	90	66	56	48	42	36
129	12	267	138	93	74	58	51	44	41
130	12	267	138	93	74	58	51	44	41
131	12	271	138	94	74	60	51	45	41
132	12	271	138	94	74	60	51	45	41

133	12	275	141	97	74	61	53	46	41
134	12	275	141	97	74	61	53	46	41
135	12	277	141	97	74	61	53	46	41
136	12	277	141	97	74	61	53	46	41
137	12	282	144	98	76	61	53	46	41
138	12	282	144	98	76	61	53	46	41
139	12	287	146	100	77	62	53	47	41
140	12	287	146	100	77	62	53	47	41
141	12	291	149	100	78	64	53	49	42
142	12	291	149	100	78	64	53	49	42
143	12	293	149	100	78	64	53	49	42
144	12	293	149	100	78	64	53	49	42
145	12	299	154	104	81	64	57	50	44
146	12	299	154	104	81	64	57	50	44
147	12	303	154	104	81	65	57	50	44
148	12	303	154	104	81	65	57	50	44
149	12	307	157	104	82	66	57	51	45
150	12	307	157	104	82	66	57	51	45
151	12	309	157	106	82	68	57	51	45
152	12	309	157	106	82	68	57	51	45
153	12	314	161	108	85	68	58	51	46
154	12	314	161	108	85	68	58	51	46
155	12	318	162	109	85	68	58	53	46
156	12	318	162	109	85	68	58	53	46
157	12	321	164	111	85	68	60	53	46
158	12	321	164	111	85	68	60	53	46
159	12	323	164	111	85	68	60	53	46
160	12	323	164	111	85	68	60	53	46
161	12	332	169	115	89	74	61	53	49
162	12	332	169	115	89	74	61	53	49
163	12	335	169	117	89	74	61	53	49
164	12	335	169	117	89	74	61	53	49

165	12	339	172	117	89	74	61	53	49
166	12	339	172	117	89	74	61	53	49
167	12	341	172	117	89	74	61	53	49
168	12	341	172	117	89	74	61	53	49
169	12	347	177	121	92	74	64	57	50
170	12	347	177	121	92	74	64	57	50
171	12	352	178	122	93	76	64	57	51
172	12	352	178	122	93	76	64	57	51
173	12	355	180	122	93	77	64	57	51
174	12	355	180	122	93	77	64	57	51
175	12	357	180	124	93	77	64	57	51
176	12	357	180	124	93	77	64	57	51
177	12	363	185	125	97	78	65	58	53
178	12	363	185	125	97	78	65	58	53
179	12	367	185	126	97	79	65	58	53
180	12	367	185	126	97	79	65	58	53
181	12	372	190	129	98	81	68	58	53
182	12	372	190	129	98	81	68	58	53
183	12	374	190	129	98	81	68	60	53
184	12	374	190	129	98	81	68	60	53
185	12	379	193	130	100	81	68	60	53
186	12	379	193	130	100	81	68	60	53
187	12	383	194	132	100	82	68	61	53
188	12	383	194	132	100	82	68	61	53
189	12	386	196	132	100	82	68	61	53
190	12	386	196	132	100	82	68	61	53
191	12	388	196	132	100	84	68	61	53
192	12	388	196	132	100	84	68	61	53
193	12	395	202	138	104	85	74	61	57
194	12	395	202	138	104	85	74	61	57
195	12	398	202	138	104	85	74	62	57
196	12	398	202	138	104	85	74	62	57

197	12	402	205	138	104	85	74	64	57
198	12	402	205	138	104	85	74	64	57
199	12	404	205	140	104	85	74	64	57

Table 17: Double Elimination Bout Counts


Double Elimination Bout Counts
Bout Counts
Fighters
0
50
100
150
200
250
300
350
400
450
8
18
28
38
48
58
68
78
88
98
108
118
128
138
148
158
168
178
188
198
1 Field
2 Fields
3 Fields
4 Fields
5 Fields
6 Fields
7 Fields
8 Fields

Appendix – Triple Elimination Bout Counts

Fighters	Rounds	1 Field	2 Fields	3 Fields	4 Fields	5 Fields	6 Fields	7 Fields	8 Fields
8	9	27	15	13	9	9	9	9	9
9	11	36	21	16	15	11	11	11	11
10	10	35	21	15	14	10	10	10	10
11	10	41	22	16	15	14	10	10	10
12	10	41	22	16	15	14	10	10	10
13	12	48	27	21	17	16	15	12	12
14	11	47	27	21	16	16	15	11	11
15	12	52	28	22	17	16	16	14	12
16	11	52	28	21	17	16	15	14	11
17	12	61	34	24	21	17	17	16	15
18	12	61	34	24	21	17	17	16	15
19	12	67	35	27	22	18	17	17	16
20	12	66	35	27	22	18	17	17	16
21	12	72	39	29	23	21	17	17	16
22	12	72	39	28	23	21	17	17	16
23	12	78	42	29	24	22	18	17	17
24	12	78	42	29	24	22	18	17	17
25	12	85	46	34	27	22	21	17	17
26	12	85	46	34	27	22	21	17	17
27	12	91	47	35	28	23	22	18	17
28	12	91	47	35	28	23	22	18	17
29	13	98	52	36	29	25	23	22	18
30	13	97	52	36	29	25	23	22	18
31	13	101	52	39	29	28	23	22	18
32	13	100	52	39	29	28	23	22	18
33	13	109	59	40	34	28	24	23	22
34	13	109	59	40	34	28	24	23	22
35	13	115	60	43	35	29	25	23	22
36	13	115	60	43	35	29	25	23	22

37	13	122	65	47	36	29	28	23	23
38	13	122	65	47	36	29	28	23	23
39	13	126	65	47	36	30	28	24	23
40	13	126	65	47	36	30	28	24	23
41	13	134	71	48	39	34	29	25	23
42	13	134	71	48	39	34	29	25	23
43	13	140	71	52	39	35	29	28	23
44	13	140	71	52	39	35	29	28	23
45	14	146	77	53	42	36	30	29	25
46	14	145	77	53	42	36	30	29	25
47	14	152	79	54	44	37	31	29	26
48	14	151	79	54	44	37	31	29	26
49	14	157	83	59	47	37	34	30	29
50	14	157	83	59	47	37	34	30	29
51	14	164	85	60	47	40	35	30	29
52	14	164	85	60	47	40	35	30	29
53	14	170	89	61	48	40	36	30	29
54	14	170	89	61	48	40	36	30	29
55	14	175	92	65	49	41	37	31	30
56	14	176	92	65	49	41	37	31	30
57	14	182	96	65	53	43	37	35	30
58	14	181	96	65	53	43	37	35	30
59	14	188	97	66	53	44	37	35	30
60	14	188	97	66	53	44	37	35	30
61	14	193	100	71	53	47	40	36	30
62	14	193	100	71	53	47	40	36	30
63	14	196	100	71	53	47	40	36	30
64	14	196	100	71	53	47	40	36	30
65	14	206	107	72	59	48	40	37	35
66	14	206	107	72	59	48	40	37	35
67	14	212	108	75	60	48	41	37	35
68	14	212	108	75	60	48	41	37	35

69	14	219	114	78	61	49	43	37	36
70	14	219	114	78	61	49	43	37	36
71	14	224	115	79	61	52	44	40	36
72	14	224	115	79	61	52	44	40	36
73	15	230	120	83	66	54	48	41	38
74	15	230	120	83	66	54	48	41	38
75	15	236	121	84	66	54	48	41	38
76	15	236	121	84	66	54	48	41	38
77	15	242	125	85	66	54	48	41	38
78	15	241	125	85	66	54	48	41	38
79	15	247	126	89	67	55	48	41	38
80	15	247	126	89	67	55	48	41	38
81	15	254	132	90	72	59	49	44	41
82	15	254	132	90	71	59	49	44	41
83	15	261	134	92	73	59	50	45	41
84	15	260	134	92	73	59	50	45	41
85	15	267	138	96	73	61	53	48	41
86	15	266	138	96	73	61	53	48	41
87	15	273	141	97	73	62	54	48	41
88	15	274	141	97	73	62	54	48	41
89	15	279	144	98	76	62	54	48	41
90	15	278	144	98	76	62	54	48	41
91	15	283	146	101	78	66	54	48	43
92	15	283	145	101	78	66	54	48	43
93	15	290	150	101	79	66	54	49	44
94	15	290	150	101	79	66	54	49	44
95	15	294	150	101	79	66	54	49	44
96	15	294	150	101	79	66	54	49	44
97	15	303	155	107	83	66	59	50	48
98	15	303	155	107	83	66	59	50	48
99	15	309	156	107	83	67	59	53	48
100	15	309	156	107	83	67	59	53	48

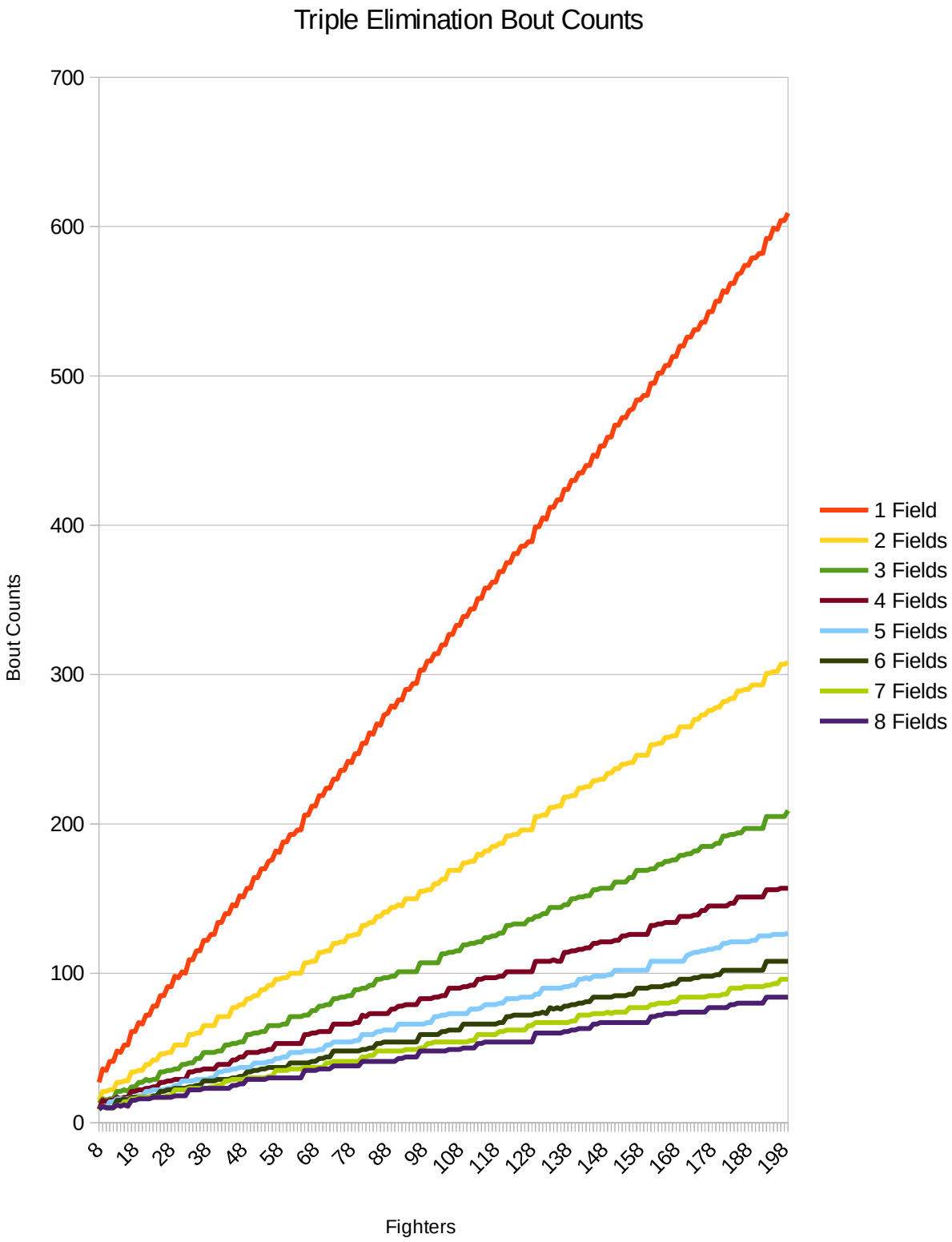
101	15	314	160	107	84	71	59	54	48
102	15	314	160	107	84	71	59	54	48
103	15	320	163	113	85	72	61	54	48
104	15	320	163	113	85	72	61	54	48
105	15	327	169	114	90	73	62	54	49
106	15	327	169	114	90	73	62	54	49
107	15	333	169	115	90	73	62	54	49
108	15	333	169	115	90	73	62	54	49
109	15	339	174	119	91	73	66	54	50
110	15	339	174	119	91	73	66	54	50
111	15	344	175	120	92	76	66	55	50
112	15	344	175	120	92	76	66	55	50
113	15	351	180	121	96	76	66	59	53
114	15	351	179	121	96	77	66	59	53
115	15	358	182	124	97	79	66	59	54
116	15	358	182	124	97	79	66	59	54
117	15	362	185	125	97	79	66	59	54
118	15	362	185	125	97	79	66	59	54
119	15	369	187	127	98	80	67	61	54
120	15	369	187	127	98	80	67	61	54
121	15	375	192	132	101	83	71	62	54
122	15	375	192	132	101	83	71	62	54
123	15	381	193	133	101	83	72	62	54
124	15	381	193	133	101	83	72	62	54
125	15	386	196	133	101	84	72	62	54
126	15	386	196	133	101	84	72	62	54
127	15	389	196	136	101	84	72	65	54
128	15	389	196	136	101	84	72	65	54
129	16	399	205	138	108	86	73	67	60
130	15	399	205	138	108	86	73	67	60
131	16	405	206	140	108	90	74	67	60
132	16	404	206	140	108	90	73	67	60

133	16	412	211	144	108	90	77	67	60
134	16	412	211	144	109	90	76	67	60
135	16	417	212	144	108	90	77	67	60
136	16	417	212	144	108	90	76	67	60
137	16	424	218	146	114	91	78	67	61
138	16	424	218	146	114	91	78	67	61
139	16	430	219	150	115	92	79	68	62
140	16	430	219	150	115	92	79	68	62
141	16	435	224	151	116	96	80	72	63
142	16	435	224	151	116	96	80	72	63
143	16	440	225	152	117	97	81	72	63
144	16	440	225	152	117	96	81	72	63
145	16	447	229	156	120	98	84	73	66
146	16	446	229	156	120	98	84	73	66
147	16	453	230	157	121	98	84	73	67
148	16	453	230	157	121	98	84	73	67
149	16	459	234	157	121	99	84	74	67
150	16	459	234	157	121	99	84	73	67
151	16	467	237	161	122	102	85	74	67
152	16	467	237	161	122	102	85	74	67
153	16	472	240	161	125	102	85	74	67
154	16	472	240	161	125	102	85	74	67
155	16	477	241	164	126	102	86	77	67
156	16	478	241	164	126	102	86	77	67
157	16	484	246	169	126	102	90	77	67
158	16	484	246	169	126	102	90	77	67
159	16	487	246	169	126	102	90	77	67
160	16	487	246	169	126	102	90	77	67
161	16	495	253	170	132	108	91	79	71
162	16	495	253	170	132	108	91	79	71
163	16	502	254	173	133	108	91	80	72
164	16	502	254	173	133	108	91	80	72

165	16	507	258	175	134	108	92	80	73
166	16	507	258	175	134	108	92	80	73
167	16	513	259	176	134	108	93	81	73
168	16	513	259	176	134	108	93	81	73
169	16	520	265	179	138	108	96	84	74
170	16	520	265	179	138	108	96	84	74
171	16	526	265	180	138	112	96	84	74
172	16	526	265	180	138	113	96	84	74
173	16	531	270	182	139	114	97	84	74
174	16	531	270	182	139	114	97	84	74
175	16	536	273	185	142	115	98	84	74
176	16	536	273	185	142	115	98	84	74
177	16	543	276	185	145	116	98	85	77
178	16	543	276	185	145	116	98	85	77
179	16	550	278	187	145	117	99	85	77
180	16	550	278	187	145	117	99	85	77
181	16	557	282	192	145	120	102	86	77
182	16	556	282	192	145	120	102	86	77
183	16	562	284	193	147	121	102	90	79
184	16	562	284	193	147	121	102	90	79
185	16	568	289	194	151	121	102	90	80
186	16	569	289	194	151	121	102	90	80
187	16	574	290	197	151	121	102	91	80
188	16	574	290	197	151	121	102	91	80
189	16	579	293	197	151	122	102	91	80
190	16	579	293	197	151	122	102	91	80
191	16	582	293	197	151	125	102	91	80
192	16	582	293	197	151	125	102	91	80
193	16	592	301	205	156	125	108	92	84
194	16	592	301	205	156	125	108	92	84
195	16	599	302	205	156	126	108	93	84
196	16	598	302	205	156	126	108	93	84

197	16	604	307	205	157	126	108	96	84
198	16	604	307	205	157	126	108	96	84
199	16	609	308	209	157	127	108	96	84

Table 18: Triple Elimination Bout Counts

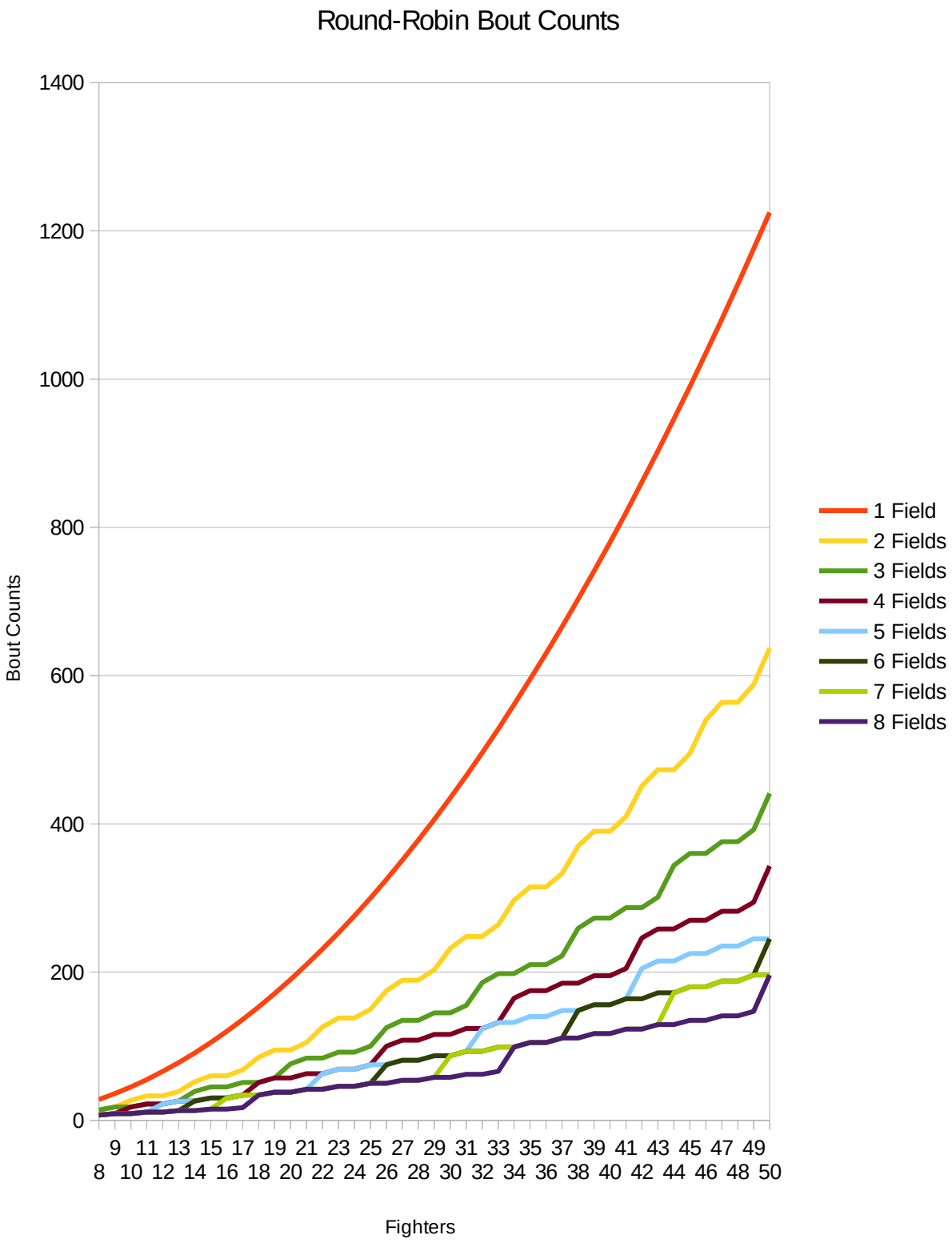

Triple Elimination Bout Counts
Bout Counts
700
600
500
400
300
200
100
0
8
18
28
38
48
58
68
78
88
98
108
118
128
138
148
158
168
178
188
198
Fighters
1 Field
2 Fields
3 Fields
4 Fields
5 Fields
6 Fields
7 Fields
8 Fields

Appendix – Round-Robin Bout Counts

Fighters	Rounds	1 Field	2 Fields	3 Fields	4 Fields	5 Fields	6 Fields	7 Fields	8 Fields
8	7	28	14	14	7	7	7	7	7
9	9	36	18	18	9	9	9	9	9
10	9	45	27	18	18	9	9	9	9
11	11	55	33	22	22	11	11	11	11
12	11	66	33	22	22	22	11	11	11
13	13	78	39	26	26	26	13	13	13
14	13	91	52	39	26	26	26	13	13
15	15	105	60	45	30	30	30	15	15
16	15	120	60	45	30	30	30	30	15
17	17	136	68	51	34	34	34	34	17
18	17	153	85	51	51	34	34	34	34
19	19	171	95	57	57	38	38	38	38
20	19	190	95	76	57	38	38	38	38
21	21	210	105	84	63	42	42	42	42
22	21	231	126	84	63	63	42	42	42
23	23	253	138	92	69	69	46	46	46
24	23	276	138	92	69	69	46	46	46
25	25	300	150	100	75	75	50	50	50
26	25	325	175	125	100	75	75	50	50
27	27	351	189	135	108	81	81	54	54
28	27	378	189	135	108	81	81	54	54
29	29	406	203	145	116	87	87	58	58
30	29	435	232	145	116	87	87	87	58
31	31	465	248	155	124	93	93	93	62
32	31	496	248	186	124	124	93	93	62
33	33	528	264	198	132	132	99	99	66
34	33	561	297	198	165	132	99	99	99
35	35	595	315	210	175	140	105	105	105
36	35	630	315	210	175	140	105	105	105

37	37	666	333	222	185	148	111	111	111
38	37	703	370	259	185	148	148	111	111
39	39	741	390	273	195	156	156	117	117
40	39	780	390	273	195	156	156	117	117
41	41	820	410	287	205	164	164	123	123
42	41	861	451	287	246	205	164	123	123
43	43	903	473	301	258	215	172	129	129
44	43	946	473	344	258	215	172	172	129
45	45	990	495	360	270	225	180	180	135
46	45	1035	540	360	270	225	180	180	135
47	47	1081	564	376	282	235	188	188	141
48	47	1128	564	376	282	235	188	188	141
49	49	1176	588	392	294	245	196	196	147
50	49	1225	637	441	343	245	245	196	196

Table 19: Round Robin Bout Counts


Round-Robin Bout Counts
Bout Counts
1400
1200
1000
800
600
400
200
0
9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49
8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
Fighters
1 Field
2 Fields
3 Fields
4 Fields
5 Fields
6 Fields
7 Fields
8 Fields

Appendix – Swiss-5 Bout Counts

Fighters	Rounds	1 Field	2 Fields	3 Fields	4 Fields	5 Fields	6 Fields	7 Fields	8 Fields
8	5	20	10	10	5	5	5	5	5
9	5	25	15	10	10	5	5	5	5
10	5	25	15	10	10	5	5	5	5
11	5	30	15	10	10	10	5	5	5
12	5	30	15	10	10	10	5	5	5
13	5	35	20	15	10	10	10	5	5
14	5	35	20	15	10	10	10	5	5
15	5	40	20	15	10	10	10	10	5
16	5	40	20	15	10	10	10	10	5
17	5	45	25	15	15	10	10	10	10
18	5	45	25	15	15	10	10	10	10
19	5	50	25	20	15	10	10	10	10
20	5	50	25	20	15	10	10	10	10
21	5	55	30	20	15	15	10	10	10
22	5	55	30	20	15	15	10	10	10
23	5	60	30	20	15	15	10	10	10
24	5	60	30	20	15	15	10	10	10
25	5	65	35	25	20	15	15	10	10
26	5	65	35	25	20	15	15	10	10
27	5	70	35	25	20	15	15	10	10
28	5	70	35	25	20	15	15	10	10
29	5	75	40	25	20	15	15	15	10
30	5	75	40	25	20	15	15	15	10
31	5	80	40	30	20	20	15	15	10
32	5	80	40	30	20	20	15	15	10
33	5	85	45	30	25	20	15	15	15
34	5	85	45	30	25	20	15	15	15
35	5	90	45	30	25	20	15	15	15
36	5	90	45	30	25	20	15	15	15

37	5	95	50	35	25	20	20	15	15
38	5	95	50	35	25	20	20	15	15
39	5	100	50	35	25	20	20	15	15
40	5	100	50	35	25	20	20	15	15
41	5	105	55	35	30	25	20	15	15
42	5	105	55	35	30	25	20	15	15
43	5	110	55	40	30	25	20	20	15
44	5	110	55	40	30	25	20	20	15
45	5	115	60	40	30	25	20	20	15
46	5	115	60	40	30	25	20	20	15
47	5	120	60	40	30	25	20	20	15
48	5	120	60	40	30	25	20	20	15
49	5	125	65	45	35	25	25	20	20
50	5	125	65	45	35	25	25	20	20
51	5	130	65	45	35	30	25	20	20
52	5	130	65	45	35	30	25	20	20
53	5	135	70	45	35	30	25	20	20
54	5	135	70	45	35	30	25	20	20
55	5	140	70	50	35	30	25	20	20
56	5	140	70	50	35	30	25	20	20
57	5	145	75	50	40	30	25	25	20
58	5	145	75	50	40	30	25	25	20
59	5	150	75	50	40	30	25	25	20
60	5	150	75	50	40	30	25	25	20
61	5	155	80	55	40	35	30	25	20
62	5	155	80	55	40	35	30	25	20
63	5	160	80	55	40	35	30	25	20
64	5	160	80	55	40	35	30	25	20
65	5	165	85	55	45	35	30	25	25
66	5	165	85	55	45	35	30	25	25
67	5	170	85	60	45	35	30	25	25
68	5	170	85	60	45	35	30	25	25

69	5	175	90	60	45	35	30	25	25
70	5	175	90	60	45	35	30	25	25
71	5	180	90	60	45	40	30	30	25
72	5	180	90	60	45	40	30	30	25
73	5	185	95	65	50	40	35	30	25
74	5	185	95	65	50	40	35	30	25
75	5	190	95	65	50	40	35	30	25
76	5	190	95	65	50	40	35	30	25
77	5	195	100	65	50	40	35	30	25
78	5	195	100	65	50	40	35	30	25
79	5	200	100	70	50	40	35	30	25
80	5	200	100	70	50	40	35	30	25
81	5	205	105	70	55	45	35	30	30
82	5	205	105	70	55	45	35	30	30
83	5	210	105	70	55	45	35	30	30
84	5	210	105	70	55	45	35	30	30
85	5	215	110	75	55	45	40	35	30
86	5	215	110	75	55	45	40	35	30
87	5	220	110	75	55	45	40	35	30
88	5	220	110	75	55	45	40	35	30
89	5	225	115	75	60	45	40	35	30
90	5	225	115	75	60	45	40	35	30
91	5	230	115	80	60	50	40	35	30
92	5	230	115	80	60	50	40	35	30
93	5	235	120	80	60	50	40	35	30
94	5	235	120	80	60	50	40	35	30
95	5	240	120	80	60	50	40	35	30
96	5	240	120	80	60	50	40	35	30
97	5	245	125	85	65	50	45	35	35
98	5	245	125	85	65	50	45	35	35
99	5	250	125	85	65	50	45	40	35
100	5	250	125	85	65	50	45	40	35

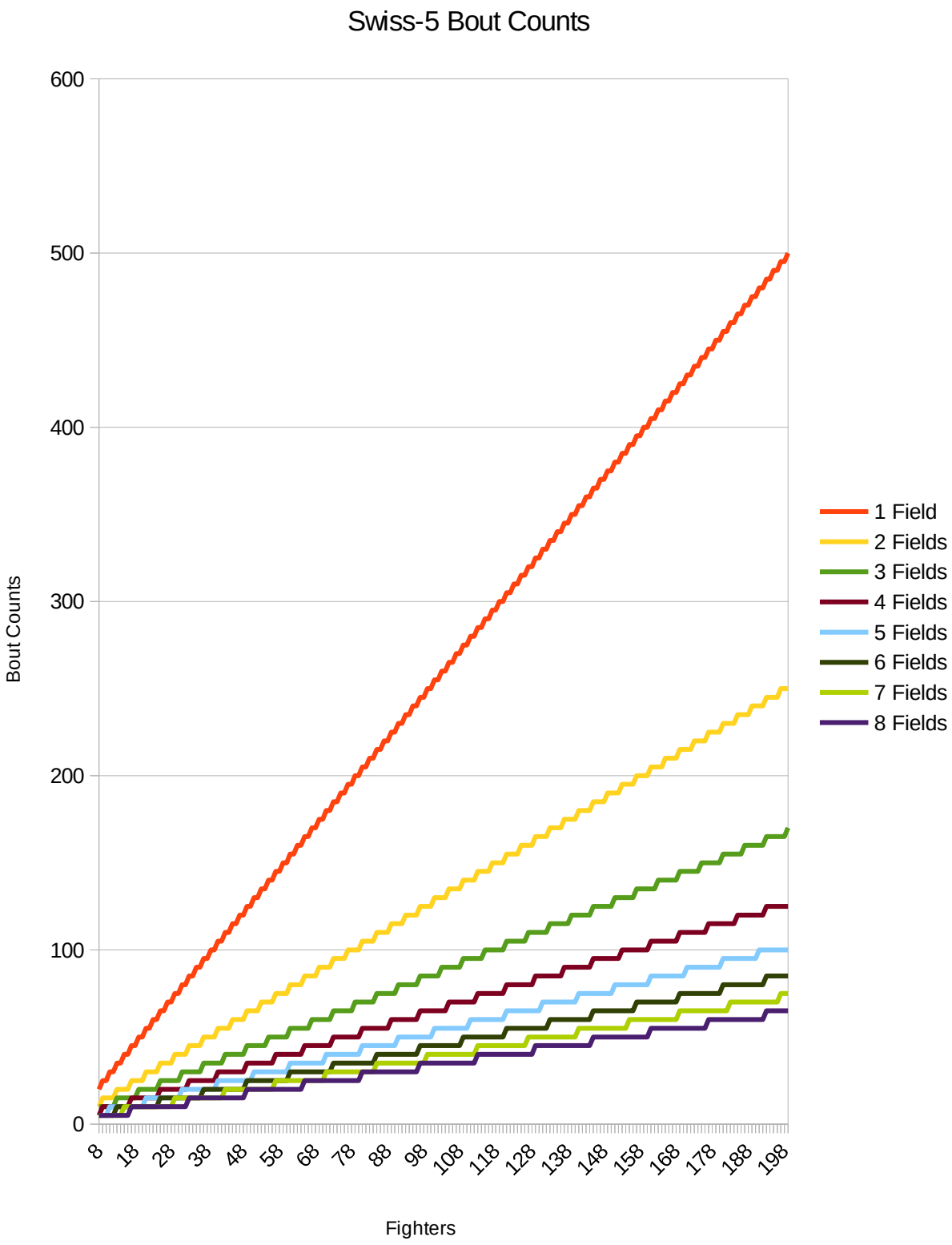
101	5	255	130	85	65	55	45	40	35
102	5	255	130	85	65	55	45	40	35
103	5	260	130	90	65	55	45	40	35
104	5	260	130	90	65	55	45	40	35
105	5	265	135	90	70	55	45	40	35
106	5	265	135	90	70	55	45	40	35
107	5	270	135	90	70	55	45	40	35
108	5	270	135	90	70	55	45	40	35
109	5	275	140	95	70	55	50	40	35
110	5	275	140	95	70	55	50	40	35
111	5	280	140	95	70	60	50	40	35
112	5	280	140	95	70	60	50	40	35
113	5	285	145	95	75	60	50	45	40
114	5	285	145	95	75	60	50	45	40
115	5	290	145	100	75	60	50	45	40
116	5	290	145	100	75	60	50	45	40
117	5	295	150	100	75	60	50	45	40
118	5	295	150	100	75	60	50	45	40
119	5	300	150	100	75	60	50	45	40
120	5	300	150	100	75	60	50	45	40
121	5	305	155	105	80	65	55	45	40
122	5	305	155	105	80	65	55	45	40
123	5	310	155	105	80	65	55	45	40
124	5	310	155	105	80	65	55	45	40
125	5	315	160	105	80	65	55	45	40
126	5	315	160	105	80	65	55	45	40
127	5	320	160	110	80	65	55	50	40
128	5	320	160	110	80	65	55	50	40
129	5	325	165	110	85	65	55	50	45
130	5	325	165	110	85	65	55	50	45
131	5	330	165	110	85	70	55	50	45
132	5	330	165	110	85	70	55	50	45

133	5	335	170	115	85	70	60	50	45
134	5	335	170	115	85	70	60	50	45
135	5	340	170	115	85	70	60	50	45
136	5	340	170	115	85	70	60	50	45
137	5	345	175	115	90	70	60	50	45
138	5	345	175	115	90	70	60	50	45
139	5	350	175	120	90	70	60	50	45
140	5	350	175	120	90	70	60	50	45
141	5	355	180	120	90	75	60	55	45
142	5	355	180	120	90	75	60	55	45
143	5	360	180	120	90	75	60	55	45
144	5	360	180	120	90	75	60	55	45
145	5	365	185	125	95	75	65	55	50
146	5	365	185	125	95	75	65	55	50
147	5	370	185	125	95	75	65	55	50
148	5	370	185	125	95	75	65	55	50
149	5	375	190	125	95	75	65	55	50
150	5	375	190	125	95	75	65	55	50
151	5	380	190	130	95	80	65	55	50
152	5	380	190	130	95	80	65	55	50
153	5	385	195	130	100	80	65	55	50
154	5	385	195	130	100	80	65	55	50
155	5	390	195	130	100	80	65	60	50
156	5	390	195	130	100	80	65	60	50
157	5	395	200	135	100	80	70	60	50
158	5	395	200	135	100	80	70	60	50
159	5	400	200	135	100	80	70	60	50
160	5	400	200	135	100	80	70	60	50
161	5	405	205	135	105	85	70	60	55
162	5	405	205	135	105	85	70	60	55
163	5	410	205	140	105	85	70	60	55
164	5	410	205	140	105	85	70	60	55

165	5	415	210	140	105	85	70	60	55
166	5	415	210	140	105	85	70	60	55
167	5	420	210	140	105	85	70	60	55
168	5	420	210	140	105	85	70	60	55
169	5	425	215	145	110	85	75	65	55
170	5	425	215	145	110	85	75	65	55
171	5	430	215	145	110	90	75	65	55
172	5	430	215	145	110	90	75	65	55
173	5	435	220	145	110	90	75	65	55
174	5	435	220	145	110	90	75	65	55
175	5	440	220	150	110	90	75	65	55
176	5	440	220	150	110	90	75	65	55
177	5	445	225	150	115	90	75	65	60
178	5	445	225	150	115	90	75	65	60
179	5	450	225	150	115	90	75	65	60
180	5	450	225	150	115	90	75	65	60
181	5	455	230	155	115	95	80	65	60
182	5	455	230	155	115	95	80	65	60
183	5	460	230	155	115	95	80	70	60
184	5	460	230	155	115	95	80	70	60
185	5	465	235	155	120	95	80	70	60
186	5	465	235	155	120	95	80	70	60
187	5	470	235	160	120	95	80	70	60
188	5	470	235	160	120	95	80	70	60
189	5	475	240	160	120	95	80	70	60
190	5	475	240	160	120	95	80	70	60
191	5	480	240	160	120	100	80	70	60
192	5	480	240	160	120	100	80	70	60
193	5	485	245	165	125	100	85	70	65
194	5	485	245	165	125	100	85	70	65
195	5	490	245	165	125	100	85	70	65
196	5	490	245	165	125	100	85	70	65

197	5	495	250	165	125	100	85	75	65
198	5	495	250	165	125	100	85	75	65
199	5	500	250	170	125	100	85	75	65

Table 20: Swiss-5 Bout Counts


Swiss-5 Bout Counts
600
500
400
300
200
100
0
Bout Counts
8
18
28
38
48
58
68
78
88
98
108
118
128
138
148
158
168
178
188
198
Fighters
1 Field
2 Fields
3 Fields
4 Fields
5 Fields
6 Fields
7 Fields
8 Fields

Appendix – Swiss-8 Bout Counts

Fighters	Rounds	1 Field	2 Fields	3 Fields	4 Fields	5 Fields	6 Fields	7 Fields	8 Fields
8	8	32	16	16	8	8	8	8	8
9	8	40	24	16	16	8	8	8	8
10	8	40	24	16	16	8	8	8	8
11	8	48	24	16	16	16	8	8	8
12	8	48	24	16	16	16	8	8	8
13	8	56	32	24	16	16	16	8	8
14	8	56	32	24	16	16	16	8	8
15	8	64	32	24	16	16	16	16	8
16	8	64	32	24	16	16	16	16	8
17	8	72	40	24	24	16	16	16	16
18	8	72	40	24	24	16	16	16	16
19	8	80	40	32	24	16	16	16	16
20	8	80	40	32	24	16	16	16	16
21	8	88	48	32	24	24	16	16	16
22	8	88	48	32	24	24	16	16	16
23	8	96	48	32	24	24	16	16	16
24	8	96	48	32	24	24	16	16	16
25	8	104	56	40	32	24	24	16	16
26	8	104	56	40	32	24	24	16	16
27	8	112	56	40	32	24	24	16	16
28	8	112	56	40	32	24	24	16	16
29	8	120	64	40	32	24	24	24	16
30	8	120	64	40	32	24	24	24	16
31	8	128	64	48	32	32	24	24	16
32	8	128	64	48	32	32	24	24	16
33	8	136	72	48	40	32	24	24	24
34	8	136	72	48	40	32	24	24	24
35	8	144	72	48	40	32	24	24	24
36	8	144	72	48	40	32	24	24	24

37	8	152	80	56	40	32	32	24	24
38	8	152	80	56	40	32	32	24	24
39	8	160	80	56	40	32	32	24	24
40	8	160	80	56	40	32	32	24	24
41	8	168	88	56	48	40	32	24	24
42	8	168	88	56	48	40	32	24	24
43	8	176	88	64	48	40	32	32	24
44	8	176	88	64	48	40	32	32	24
45	8	184	96	64	48	40	32	32	24
46	8	184	96	64	48	40	32	32	24
47	8	192	96	64	48	40	32	32	24
48	8	192	96	64	48	40	32	32	24
49	8	200	104	72	56	40	40	32	32
50	8	200	104	72	56	40	40	32	32
51	8	208	104	72	56	48	40	32	32
52	8	208	104	72	56	48	40	32	32
53	8	216	112	72	56	48	40	32	32
54	8	216	112	72	56	48	40	32	32
55	8	224	112	80	56	48	40	32	32
56	8	224	112	80	56	48	40	32	32
57	8	232	120	80	64	48	40	40	32
58	8	232	120	80	64	48	40	40	32
59	8	240	120	80	64	48	40	40	32
60	8	240	120	80	64	48	40	40	32
61	8	248	128	88	64	56	48	40	32
62	8	248	128	88	64	56	48	40	32
63	8	256	128	88	64	56	48	40	32
64	8	256	128	88	64	56	48	40	32
65	8	264	136	88	72	56	48	40	40
66	8	264	136	88	72	56	48	40	40
67	8	272	136	96	72	56	48	40	40
68	8	272	136	96	72	56	48	40	40

69	8	280	144	96	72	56	48	40	40
70	8	280	144	96	72	56	48	40	40
71	8	288	144	96	72	64	48	48	40
72	8	288	144	96	72	64	48	48	40
73	8	296	152	104	80	64	56	48	40
74	8	296	152	104	80	64	56	48	40
75	8	304	152	104	80	64	56	48	40
76	8	304	152	104	80	64	56	48	40
77	8	312	160	104	80	64	56	48	40
78	8	312	160	104	80	64	56	48	40
79	8	320	160	112	80	64	56	48	40
80	8	320	160	112	80	64	56	48	40
81	8	328	168	112	88	72	56	48	48
82	8	328	168	112	88	72	56	48	48
83	8	336	168	112	88	72	56	48	48
84	8	336	168	112	88	72	56	48	48
85	8	344	176	120	88	72	64	56	48
86	8	344	176	120	88	72	64	56	48
87	8	352	176	120	88	72	64	56	48
88	8	352	176	120	88	72	64	56	48
89	8	360	184	120	96	72	64	56	48
90	8	360	184	120	96	72	64	56	48
91	8	368	184	128	96	80	64	56	48
92	8	368	184	128	96	80	64	56	48
93	8	376	192	128	96	80	64	56	48
94	8	376	192	128	96	80	64	56	48
95	8	384	192	128	96	80	64	56	48
96	8	384	192	128	96	80	64	56	48
97	8	392	200	136	104	80	72	56	56
98	8	392	200	136	104	80	72	56	56
99	8	400	200	136	104	80	72	64	56
100	8	400	200	136	104	80	72	64	56

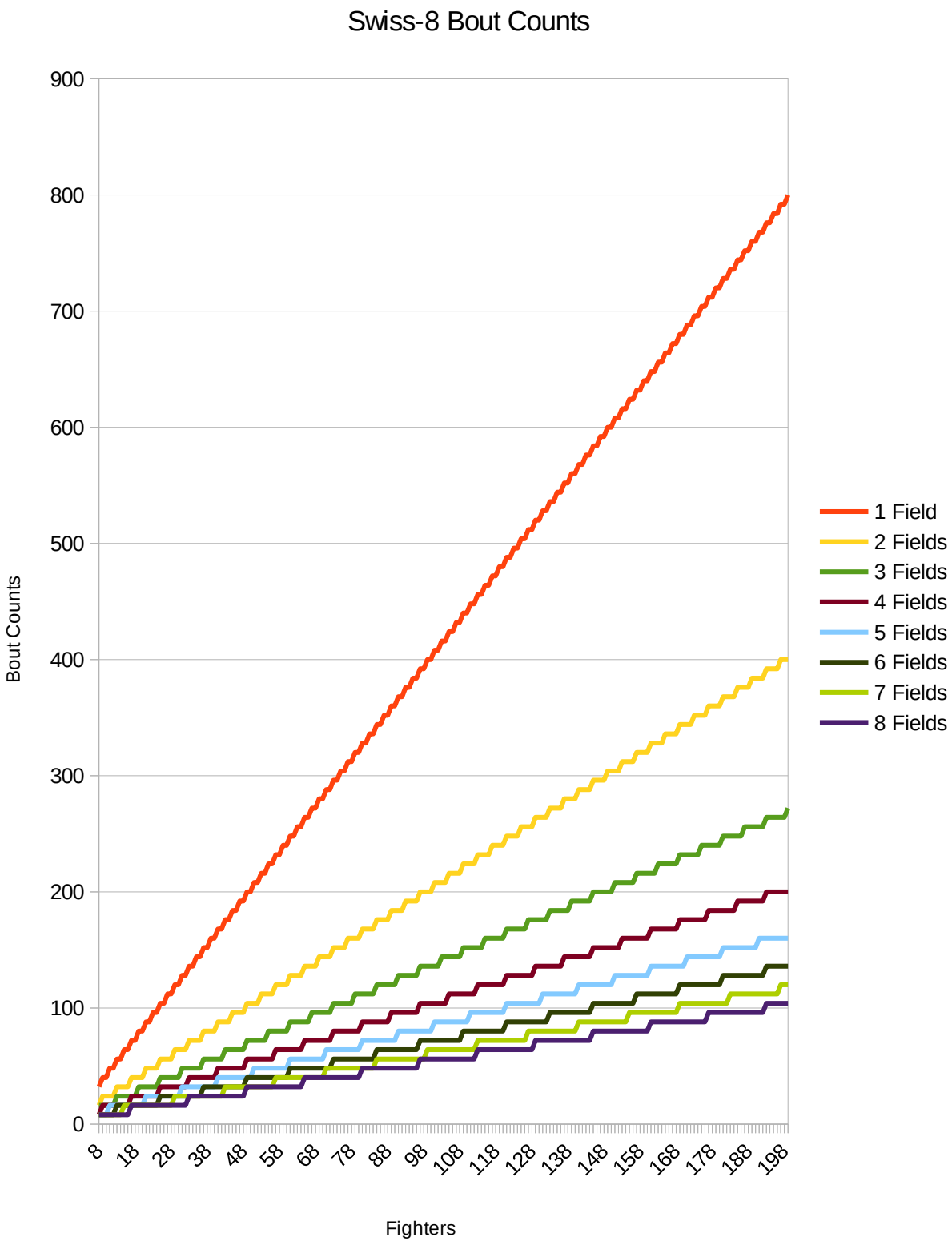
101	8	408	208	136	104	88	72	64	56
102	8	408	208	136	104	88	72	64	56
103	8	416	208	144	104	88	72	64	56
104	8	416	208	144	104	88	72	64	56
105	8	424	216	144	112	88	72	64	56
106	8	424	216	144	112	88	72	64	56
107	8	432	216	144	112	88	72	64	56
108	8	432	216	144	112	88	72	64	56
109	8	440	224	152	112	88	80	64	56
110	8	440	224	152	112	88	80	64	56
111	8	448	224	152	112	96	80	64	56
112	8	448	224	152	112	96	80	64	56
113	8	456	232	152	120	96	80	72	64
114	8	456	232	152	120	96	80	72	64
115	8	464	232	160	120	96	80	72	64
116	8	464	232	160	120	96	80	72	64
117	8	472	240	160	120	96	80	72	64
118	8	472	240	160	120	96	80	72	64
119	8	480	240	160	120	96	80	72	64
120	8	480	240	160	120	96	80	72	64
121	8	488	248	168	128	104	88	72	64
122	8	488	248	168	128	104	88	72	64
123	8	496	248	168	128	104	88	72	64
124	8	496	248	168	128	104	88	72	64
125	8	504	256	168	128	104	88	72	64
126	8	504	256	168	128	104	88	72	64
127	8	512	256	176	128	104	88	80	64
128	8	512	256	176	128	104	88	80	64
129	8	520	264	176	136	104	88	80	72
130	8	520	264	176	136	104	88	80	72
131	8	528	264	176	136	112	88	80	72
132	8	528	264	176	136	112	88	80	72

133	8	536	272	184	136	112	96	80	72
134	8	536	272	184	136	112	96	80	72
135	8	544	272	184	136	112	96	80	72
136	8	544	272	184	136	112	96	80	72
137	8	552	280	184	144	112	96	80	72
138	8	552	280	184	144	112	96	80	72
139	8	560	280	192	144	112	96	80	72
140	8	560	280	192	144	112	96	80	72
141	8	568	288	192	144	120	96	88	72
142	8	568	288	192	144	120	96	88	72
143	8	576	288	192	144	120	96	88	72
144	8	576	288	192	144	120	96	88	72
145	8	584	296	200	152	120	104	88	80
146	8	584	296	200	152	120	104	88	80
147	8	592	296	200	152	120	104	88	80
148	8	592	296	200	152	120	104	88	80
149	8	600	304	200	152	120	104	88	80
150	8	600	304	200	152	120	104	88	80
151	8	608	304	208	152	128	104	88	80
152	8	608	304	208	152	128	104	88	80
153	8	616	312	208	160	128	104	88	80
154	8	616	312	208	160	128	104	88	80
155	8	624	312	208	160	128	104	96	80
156	8	624	312	208	160	128	104	96	80
157	8	632	320	216	160	128	112	96	80
158	8	632	320	216	160	128	112	96	80
159	8	640	320	216	160	128	112	96	80
160	8	640	320	216	160	128	112	96	80
161	8	648	328	216	168	136	112	96	88
162	8	648	328	216	168	136	112	96	88
163	8	656	328	224	168	136	112	96	88
164	8	656	328	224	168	136	112	96	88

165	8	664	336	224	168	136	112	96	88
166	8	664	336	224	168	136	112	96	88
167	8	672	336	224	168	136	112	96	88
168	8	672	336	224	168	136	112	96	88
169	8	680	344	232	176	136	120	104	88
170	8	680	344	232	176	136	120	104	88
171	8	688	344	232	176	144	120	104	88
172	8	688	344	232	176	144	120	104	88
173	8	696	352	232	176	144	120	104	88
174	8	696	352	232	176	144	120	104	88
175	8	704	352	240	176	144	120	104	88
176	8	704	352	240	176	144	120	104	88
177	8	712	360	240	184	144	120	104	96
178	8	712	360	240	184	144	120	104	96
179	8	720	360	240	184	144	120	104	96
180	8	720	360	240	184	144	120	104	96
181	8	728	368	248	184	152	128	104	96
182	8	728	368	248	184	152	128	104	96
183	8	736	368	248	184	152	128	112	96
184	8	736	368	248	184	152	128	112	96
185	8	744	376	248	192	152	128	112	96
186	8	744	376	248	192	152	128	112	96
187	8	752	376	256	192	152	128	112	96
188	8	752	376	256	192	152	128	112	96
189	8	760	384	256	192	152	128	112	96
190	8	760	384	256	192	152	128	112	96
191	8	768	384	256	192	160	128	112	96
192	8	768	384	256	192	160	128	112	96
193	8	776	392	264	200	160	136	112	104
194	8	776	392	264	200	160	136	112	104
195	8	784	392	264	200	160	136	112	104
196	8	784	392	264	200	160	136	112	104

197	8	792	400	264	200	160	136	120	104
198	8	792	400	264	200	160	136	120	104
199	8	800	400	272	200	160	136	120	104

Table 21: Swiss-8 Bout Counts


Swiss-8 Bout Counts
Bout Counts
900
800
700
600
500
400
300
200
100
0
8
18
28
38
48
58
68
78
88
98
108
118
128
138
148
158
168
178
188
198
Fighters
1 Field
2 Fields
3 Fields
4 Fields
5 Fields
6 Fields
7 Fields
8 Fields

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