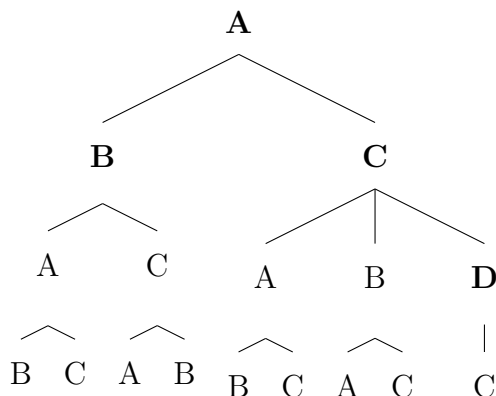# Mixed Martial Arts in Time

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1 Introduction

During the pandemic, I started to watch a lot of UFC events. I noticed an absence of time series data. Most information online would be about individual fighters, detailing their personal records. To learn more about the sport, I wrote a script to scrape the website Sherdog for tables related to MMA fights. Each table would include the outcome of the fight, who someone fought, how the fight ended (decision, knockout, etc), the date, the duration, and the referee.

2 Data Collection

I wrote the code with a tree in mind. It would begin with one fighter, extract the links to the webpages for his or her opponents, then go to each of the opponnet's page to do the same. For example, let's say there are 4 fighters: A, B, C, and D. Fighters A, B, and C have all fought each other, but D has only fought C. A tree beginning with Fighter A is pictured below.

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                        A
              ┌─────────────────┐
              B                 C
          ┌───────┐      ┌──────┬──────┐
          A       C      A      B      D
        ┌───┐   ┌───┐  ┌───┐  ┌───┐    │
        B  C   A  B   B  C   A  C      C
```

Since fighters show up on each others' trees, the tree would go on forever with only A, B, C, and D. To avoid this, I wrote my code so that I would take the first fighter, store the opponents, and for every subsequent fighter, I would only store new fighters. One caveat to my method is that I can miss some fighters. For example, if there are two fighters that only fought each other, then I won't find them using my technique. I would need to have a way of knowing every professional fighter to detect a miss. Unfortunately, the list of fighters I created is the closest to such list.

For the top of my tree, I chose Daniel Cormeir (DC). DC is a former two-time UFC Champion in both the Heavweight and Light Heavyweight divisions, with 26 professional fights (majority in the UFC). DC having such a long career and fighting in two weight classes ensures that I will get most fighters. I scraped the tables on May 9, 2022 and captured 122,181 fighters. My webscraper managed to capture both men and women, which means there was either a mixed gender fight or someone transitioned during their professional career.[1] I restrict the sample to fights that end within 15 minutes occurring between 1990 and the end of 2019. I chose the 15 minute cut-off because the UFC, and most fights in the past few years, are scheduled for three, five minute rounds.

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[1] As of writing this, I have not allocated time to figuring out which occurred or creating an indicator for sex.

3   General Trends

In Figure 1a, we see that the total number of fights began to plateau in 2011. Prior to 2011, we see a steady rise in the total number of fights. From 2005 to 2006 there is particularly noticeable increase in the number of fights, which coincides with the growth in UFC popularity.[2] Figure 1b highlights an increase in the amount of time fighters take between fights. In the mid-1990s, fighters would only take off about 100 days and by 2019, fighters spend two-thirds of a year between contests. Figure 1c documents the average number of bouts a given fighter will compete in during a year. Since 1997, the average number of fights has steadily fallen to 2 fights per year. In addition to spending more time away from competition, the bouts themselves are longer. Figure 1d shows that the average duration of fights has risen from a little under four minutes in 1995 to seven minutes in 2019, a remarkable 83% increase.[3]

Figures 1e amd 1f highlight trends in entrants and exiters i.e., new and retiring professional fighters. The proportion of bouts featuring a new fighter has been declining since the beginning of the 2000s, as seen in Figure 1e. At the same time, Figure 1f shows that the number of fighters retiring has stayed relatively stagnant compared to entry. There has been a slow increase in the number of fighters that leave the sport. In 2010, 17% of fights featured a retiring competitor compared to 23.7% in 2018, a 39.4% increase. In 2019, there is an uptick in retirements. This is likely because sports organizations stopped hosting events during the pandemic. Professional MMA, especially outside the US, has not resurged so many fighters may be active but have not had the opportunity to compete. To understand why there are fewer entrants and more retiring, more data about contracts and physical metrics such as age would be useful.

In Figure 2, I focus on how fights end. There are three main ways a fight can end:

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[2]In 2005, Spike TV launched the Ultimate Fighter 1, a reality TV ahow featuring rising MMA fighters competing for a UFC contract.

[3]The average time in 1995 is 3 minutes and 48 seconds and 6 minutes and 59 seconds in 2019.

knockout (KO), submission, and decision.[4] In Figure 2a, I plotted the average duration of fights by each method. Interestingly, fights that end with a KO or submission end at a similar time. On average, those fights end within the first round. Decisions last the longest. Judges keep score the entire fight and their decisions are used to declare a winner or a draw if the alloted time has finished without a KO or submission. While the most popular organizations now use three, five minute rounds, this has not always been the case, which is why there has been a gradual increase in the time for decisions. Figures 2b, 2c, and 2d, illustrate how common submission, decision, and KO victories are over time, respectively. Submission wins were very common in the earlier days of MMA but have fallen signficantly. My view is that Brazilian jiu-jitsu and wrestling have become more widely practiced among fighters, closing a skill gap in the ability to protect oneself against submissions. There are more decision victories, which to me signal the possibility that fighters are more skilled and more evenly matched than the earlier days of the sport. We are also seeing a rising proportion of KOs, which is likely driven by the closure in the skill gap. Fighters are spending more time on their feet, which increases the chance of landing a significant strike. More information, such as affiliations and athletic background, is needed to make a further dive into this aspect of the sport.

4   Discussion

The data collected gives a new perspective on MMA, but to understand the trends I'd like to collect more information. For example, data on contract lengths and pay will help understand what factors drive fewer entries. In addition, learning more about amateur fights or athletic backgrounds will help explain the increase in fight duration. Having physical metrics, such as age and weight, and data related to individual rounds would also be beneficial. Whille I do not have the data yet, the two most pressing questions are posed below.
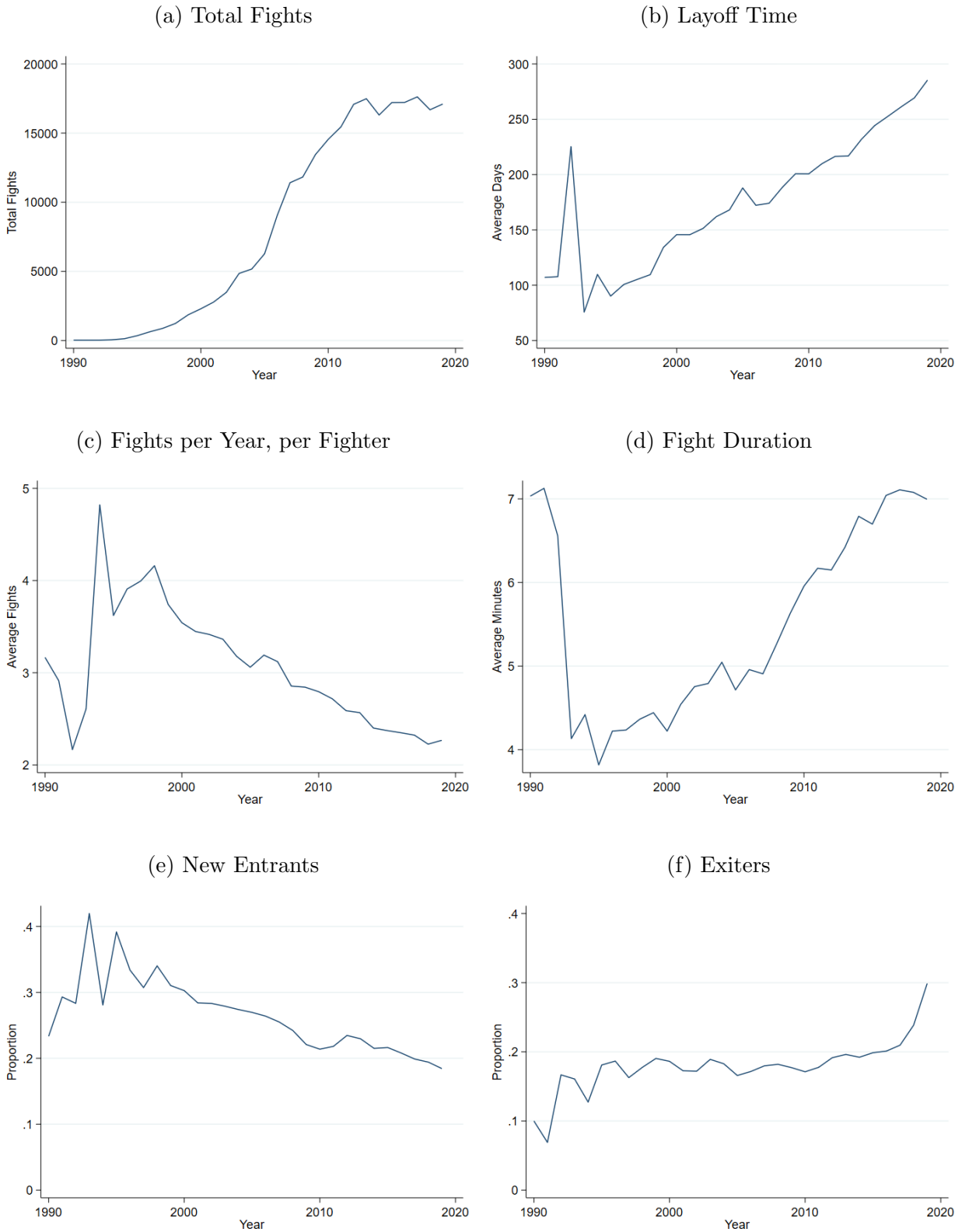
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[4]There are also draws and disqualifications.

1. Do weight cuts affect performance or recovery? There is growing concern about fighters and weight cutting. MMA fighters, like wrestlers and boxers, often compete at weight classes below their actual weight. This often involves cutting a significant portion of body weight, primarily water.[5] Seizures, kidney issues, and even death have occurred as a result of cutting weight. To analyze weight cuts, data on how much fighters weigh throughout the week or on competition day would be relevant.

2. Can we identify the worst performing judges? Every few events, there are complaints about judging decisions. Dana White, the President of the UFC, has been vocal about poor judging decisions. After UFC 239, he said, "Anybody who scored that fight for Santos is out of their mind ... you should never judge another fight if you judged for Santos." Judging affects fighter pay, ranking, and the overall quality of the sport; thus, identifying and trying to replace poor perfomers benefits athletes.

I'd also like to use the data to build a network of fighters. Fighters, like DC, who fought in multiple weight classes serve as a bridge between divisions, and I can use that to see how interconnected weight classes are. The same can be done with affiliations between different fighting camps. Fighters have coaches and typically train at specific gyms. The data on fighter affiliations is available on Sherdog, so I can use that to build a network of affiliations. There are many things that can be done with this data and in this space, and I'd be happy to collaborate with others. If you like this or want to learn more, email me.
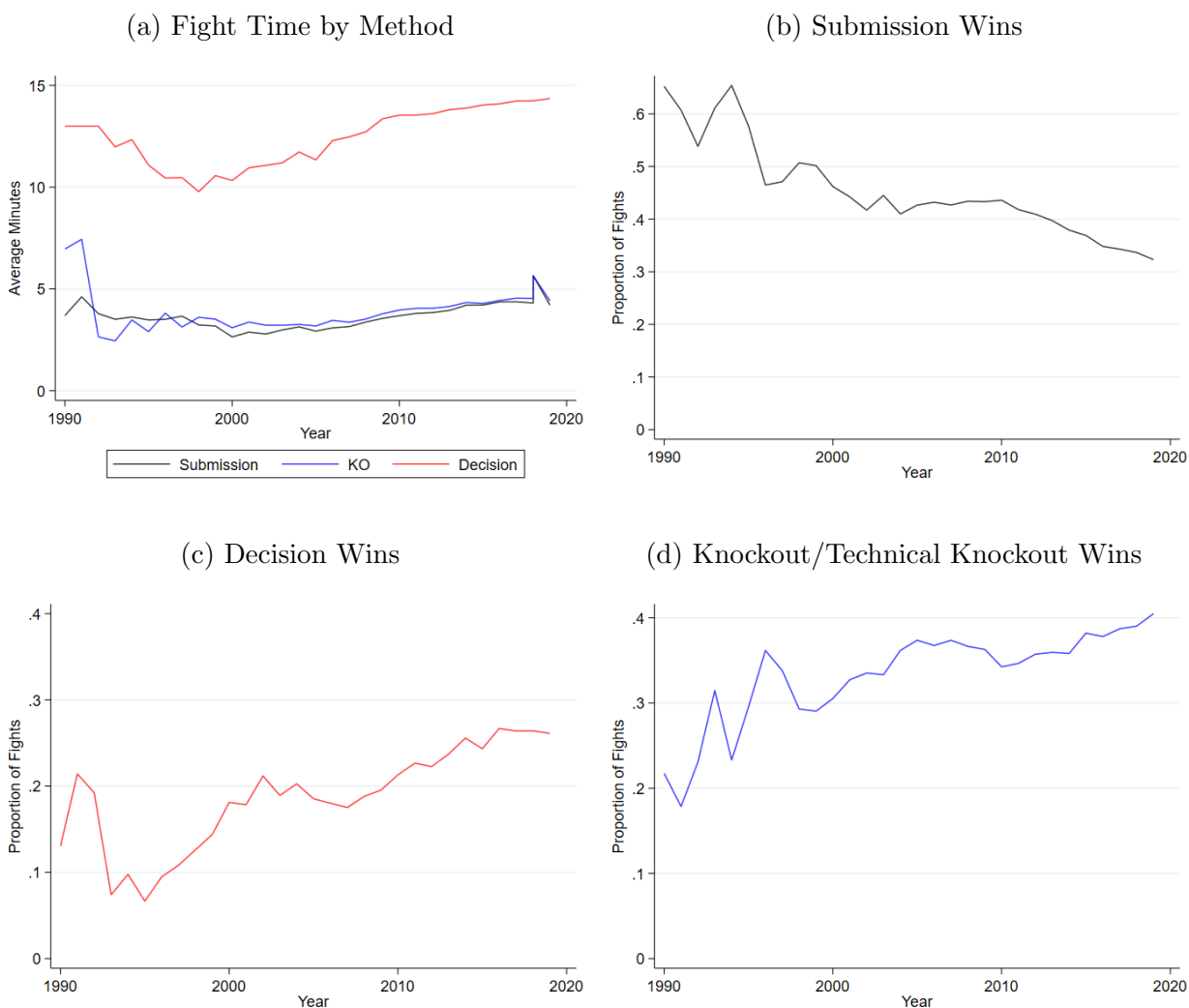
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[5]Click here for a video documenting the final days of the weight cutting process.

Figure 1: General Trends

(a) Total Fights

(b) Layoff Time

(c) Fights per Year, per Fighter

(d) Fight Duration

(e) New Entrants

(f) Exiters

Panel (a) shows the total number of fights, (b) presents the time between bouts, (c) shows the average number of fights that each fighter competes in within a year, and (d) shows how long the fight lasts. Panels (e) and (f) depict the number of new professional fighters that compete and those that retire, respectively. Sample includes fights ending within 15 minutes between 1990 to 2019.

Figure 2: How Fights End

(a) Fight Time by Method

(b) Submission Wins

(c) Decision Wins

(d) Knockout/Technical Knockout Wins

Panel (a) shows the duration of fights split by how the fight ended: decision, submission, or knockout/technical knockout. Panels (b), (c), and (d) are the proportion of wins via each method. Sample includes fights ending within 15 minutes between 1990 to 2019.