

# The BP marking system of League of Legends

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## Summary

This project focuses on building a Ban and Pick (BP) marking system in the league of legend (LOL) matches. BP is an important stage in the LOL matches, and any team will have in-depth discussion and decision on this stage before the game. It affects the style the team plays and whether they can get an advantage on the lanes.

This project uses T1 and DRX, two teams in the 2022 World Champion, to build the system. First, the study introduced the rules of LOL and the rules of the game, and then started from the champion pool of players. After that, the six stats of these champions are used to classify the champions in each position and the two conditions that need to be met by a reasonable lineup are obtained. After that, this study analyzed the counter relations between the top laner and the middle laner, and obtained the counter relation scores of each champion to other champions in the same position. Then, since each player's proficiency for each champion is different, proficiency is also an important factor in BP. In this study, four factors affecting the proficiency of these players were obtained by using their previous matches in the World Champion. Meanwhile, the dimensions were reduced by principal component analysis and the proficiency scores were obtained. Each version has a number of enhanced champions, whose stats are so much better than those of other champions that they are called overpower champions. To find them, the study compiled a list of the top 20 champions by pick and ban from data sites. Then use the character of the version champion to find the overpower champion for each position. Finally, using the above data, this study conducted training with the data exceeding 80k, and determined the value range of variables and the weight of parameters by interval scoring and entropy method, thus obtaining the BP marking system. In order to verify the effectiveness of the marking system, this study substituted the data of five sets in the final match of T1 and DRX in the World Champion into the system for analysis of the results. Finally, it is obtained that the system has the authenticity of BP result marking to a certain extent.

Certainly, the system is not perfect, because only the data of a single match into the verification, which does not show that it is universal. At the same time, the BP scores obtained by the system can only be used as one of the influencing factors for the outcome prediction of the match. Differences in team coordination and individual abilities in a real match also affect the outcome of the match.

# 1. Basic rules about League of legends (LOL)

## 1.1 Rules about game mechanics

League of Legends is a team-based strategy game where two teams of five powerful champions face off to destroy the other's base.

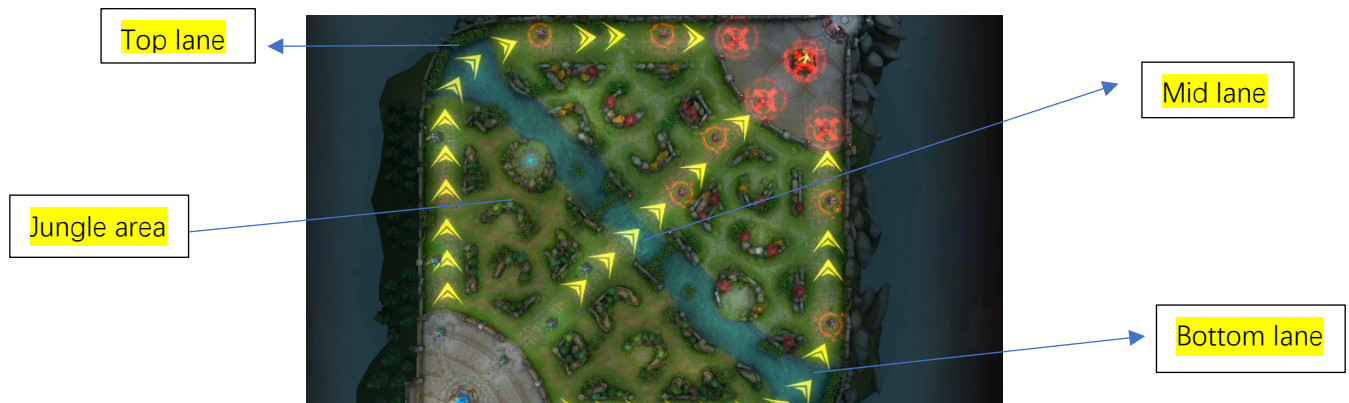


Figure 1.1 The game map of LOL

The game map involves three lanes and jungle area, and each lane has three turrets to defend base apart from enemies. Furthermore, every team will have a group of creeps walking from the three lanes to attack every few tens of seconds.

If a champion gives a creep or a neutral monster a final blow that kills it, it will obtain xp and gold. When it earns enough gold, it can purchase better equipment to be stronger when fighting with enemies and when xp is accumulated to a fixed value, it will upgrade and all stats of the champion will be enhanced. The whole rules can be found at:

<https://www.leagueoflegends.com/en-us/how-to-play/>

There are five different positions for five players in a game:

### **TOP LANE**

Champions in top lane are the tough solo fighters of the team. It's their job to protect their lane and focus on the enemy team's most powerful members.

### **JUNGLE**

Junglers live for the hunt. Stalking between lanes with stealth and skill, they keep a close eye on the most important neutral monsters and pounce the moment an opponent lets their guard down.

### **MID LANE**

Mid laners (also called ADC) are your high burst damage champions who can do it all—solo and as a team. For them, combat is a dangerous dance where they're always looking for an opportunity to outplay their opponent.

### **BOT LANE**

Bot lane champions are the dynamite of the team. As precious cargo, they need to be protected early on before amassing enough gold and experience to carry the team to victory.

## SUPPORT

Support champions are team guardians. They help keep teammates alive and primarily focus on setting up kills, protecting their teammate in bot lane until they become stronger.[1]

## 1.2 Rules about the World Champion

At the start of the match, the two teams go through a process to ban and pick (BP) five champions each. Each team will pick the optimum five champions and ban five champions that it does not hope to meet them in the match. BP is a completely vital process for every teams because an excellent BP can give a team exclusive advantages and LOL is a game dominated by champions. Therefore, many coaches belong to each team will spend a long period of time to think out a perfect BP strategy.

The World Champion in 2022 includes play-in, group and play-off three stage and 24 teams from all over the world battle for the final champion. Finally, T1 and DRX respectively defeated their semi-final opponent and they will fight for the world championship in the final match.

## 2. Champion pool of each player

Champion pool is group of champions that a player can play it at a high level. This research collects champions that ever played by all players in T1 and DRX in World Champion as shown in the following figure and data is obtained from qwer.gg.

DRX												
Kingen	Aatrox	Camille	Gragas	Fiora	Ornn	Gnar	Maokai	Sylas				Top
Pyosik	Sejuani	Kindred	Viego	Poppy	Graves	Lee Sin	Vi	Maokai				Jun
Zeka	Akali	Sylas	Azir	Galio	Orianna	Ahri	Yone					Mid
Deft	Caitlyn	Ashe	Ezreal	Varus	Draven	Kalista	Miss Fortune	Tristana				Adc
BeryL	Heimerdinger	Soraka	Ashe	Karma	Renata Glasc	Lux	Braum	Amumu	Reil	Lulu	Tahm Kench	Sup
T1												
Zeus	Camille	Yone	Jayce	Gangplank	Gragas	Jax	Aatrox	Fiora				Top
Oner	Graves	Sejuani	Viego	Vi	Nocturne	Poppy	Lee Sin					Jun
Faker	Galio	Ryze	Akali	Viktor	Azir	Lissandra						Mid
Gumayusi	Lucian	Ashe	Varus	Xayah	Aphelios	Kai'Sa	Sivir	Kalista				Adc
Keria	Nami	Renata Glasc	Heimerdinger	Tahm Kench	Thresh	Alistar	Yuumi	Soraka				Sup

Figure 2.1 The champion pool of each player in two teams

After knowing the champion pool of opponent, it is usually helpful for making BP strategy. And from the figure above, players in DRX have a wider choice when picking champions.

### 3. Champion classification

Each champion's ability and position are different. And there are even some differences between champions in the same position according to their stats which can be searched in the LOL client. The figure below is Camille's stats shown in the client.

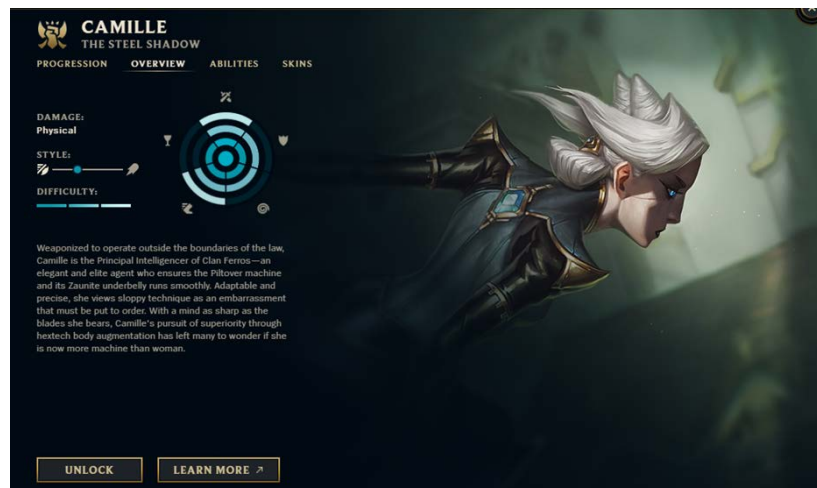


Figure 3.1 The stats of Camille

It can be found that each champion has six kinds of data deserving to be collected which are the level of damage, the level of toughness, the level of crowd control, the level of mobility, the level of utility and the type of damage. They can be used in classification.

#### 3.1 Top laner

In this position, some champions that are called tanks have higher defense and control capabilities and they can lead its team to start the team fight and take a lot of damage. Another top laner is fighter which can deal more damage to the enemy and can suppress tank in the top lane. Fighters frequently are the core of a team because of its outstanding ability to deal damage. Therefore, they can be classified by damage and toughness level. The standard of the classification is if a champion has 3 level of damage and does not have 3 level of toughness, it is a fighter. On the other hand, if a champion has 3 level of toughness and does not have 3 level of damage, it is a tank.

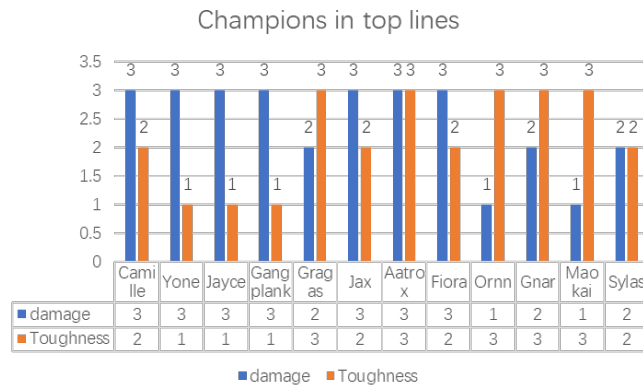


Figure 3.2 Top laners' levels of damage and toughness

tank	fighter	other
Gragas	Camille	Aatrox
Ornn	Yone	Sylas
Gnar	Jayce	
Maokai	Gangplank	
	Jax	
	Fiora	

Figure 3.3 The classification of top laners

Aatrox and Sylas in the table above do not belong to one of the two categories because of their particularity. Due to the particularity of the version, Aatrox is the highest level of damage and toughness, so he has the attributes of tank and fighter. Sylas, on the other hand, has both of these attributes and is not traditionally the best choice for top laner.

## 3.2 Jungler

This position is the core of a team, because it can lead the team to gank people on the line to gain an advantage, and can obtain wild area resources to further open the gap with the enemy. There are also two types of junglers: 1. jungle core; 2. ganker.

Jungle core is the main force of the team in the later stage, and is also the core of the team. They gank people less often than ganker on line, but do more damage in team fight.

Ganker is the rhythm initiator of the team. They are usually active in the lanes capture and acquisition of resources in the wild area. And they have the control skills in the team fight to initiate it.

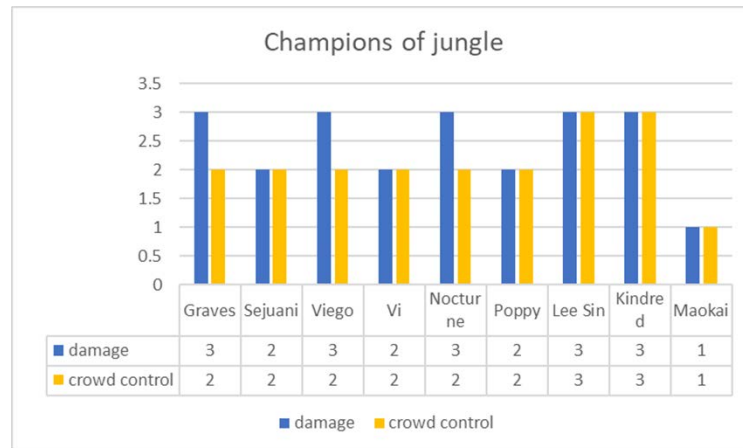


Figure 3.4 Junglers' levels of damage and toughness

jungle core	ganker
Graves	Sejuani
Viego	Vi
Nocturne	Poppy
Lee Sin	Maokai
Kindred	

Figure 3.5 The classification of junglers

### 3.3 Middle laner

The middle laner is the core lane of each team, because it not only has the shortest distance to the enemy's core, but also the middle defense tower can protect the two wild areas. Therefore, most of the champions in middle lane are the mid core of the team, and cause most of the magic damage. But at the same time, there are some champions in middle lane(called controller) who don't need too much gold to keep their equipment ahead because their skill mechanics can move quickly to help the other two lanes to gank and play key control skills in team fight. They are classified by the level of crowd control.

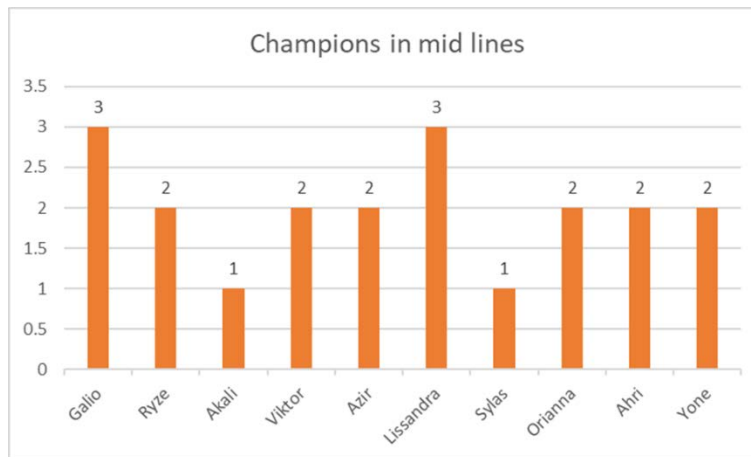


Figure 3.6 Middle laners' levels of damage and toughness

mid core	controller
Ryze	Galio
Akali	Lissandra
Viktor	
Azir	
Sylas	
Orianna	
Ahri	
Yone	

Figure 3.7 The classification of middle laners

What can be found in the table above is most middle champions are mid core, and Galio and Lissandra are controllers with the excellent level of crowd control.

### 3.4 Bottom laner(ADC)

The main damage caused by ADC of the bottom double, which is also one of the cores of the whole team. Almost all ADCs are shooters and cause physical damage. They only differ in the ability to push the lane and the difference in the skill mechanism, so there is not classification of duties.

### 3.5 Supporter

Supporters usually goes down with the ADCs. They usually assist ADCs in line matching to help ADCs gain advantages in bottom lane. Meanwhile, they are also divided into mage and tank. Since most tanks can take more damage, they tend to be the leader of a team fight. Mages cannot take too much damage, but their advantages in damage and utility can provide ADCs with more gains or control to help underdogs gain more lane rights. Therefore, they



can be classified by the level of toughness.

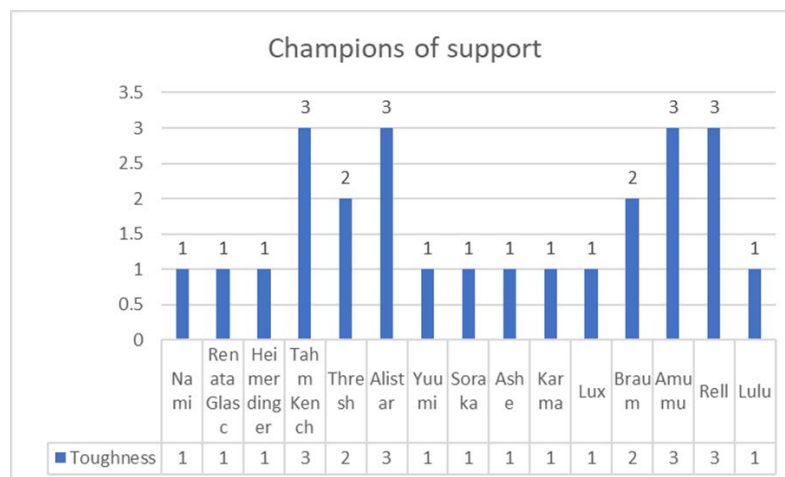


Figure 3.8 Supporters' levels of damage and toughness

tank	mage
Tahm Kench	Nami
Thresh	Renata Glasc
Alistar	Heimerdinger
Braum	Yuumi
Amumu	Soraka
Rell	Ashe
	Karma
	Lux
	Lulu

Figure 3.9 The classification of supporters

### 3.6 The principle of lineup collocation

The reasonable collocation of the lineup is one of the important factors for the team to win, in the collocation of the lineup, should follow the following principles:

- (1) There should be at least one leader of team fights;
- (2) There should be champions that deal physical damage and champions that deal magic damage.

## 4. Counter marking system

A game is divided into three stages: the laning period, the middle period and the late period. The laning period generally refers to the beginning of the game to 10-15min. And in this period, champions in three lanes are active about kill creeps and push the lane. Moreover, the wild sources refresh at 10min, so there are not many sources deserving to

contest.

In the top and middle laning period of the game, the counter relations of different champions will greatly affect the players' lane matching situation, and the advantage of lane matching can be radiated to the resource competition of the wild area, so it is necessary to find the counter relations of each other.

Sylas is middle laner in most cases, it will not be discussed here, while Yone has the same usage rate on the top lane and the middle lane, so it can be studied separately. And according to the data shown in [www.leagueofgraphs.com](http://www.leagueofgraphs.com), almost 91.7% players in their rank games choose Sylas as a middle laner and the rates of players in rank games choose Yone as a top laner and middle laner are close to 5.6:4.3, therefore it should be analyzed by its position.

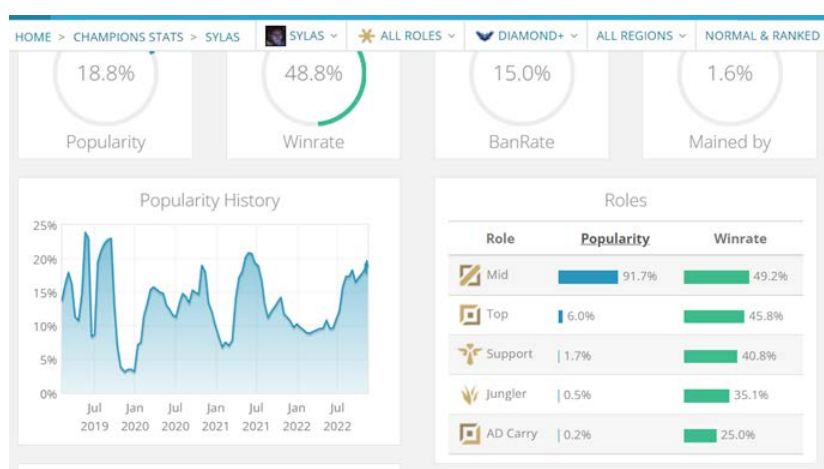


Figure 4.1 The positions of Sylas in the rank games

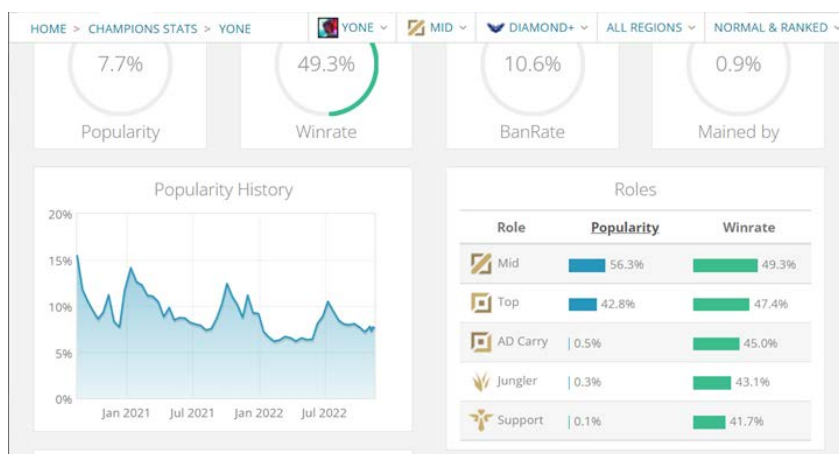


Figure 4.1 The positions of Yone in the rank games

## 4.1 Import data to Excel

The counter relations that best reflects the top and middle laners in the laning period.

Based on the data from [www.leagueofgraphs.com](http://www.leagueofgraphs.com), it can import each champion's economic lead and win percentage against each other to Excel.

win rate of	Camille	Yone	Jayce	Gangplank	Gragas	Jax	Aatrox	Flora	Ornn	Gnar	Maokai
Camille		1.40%	-6.70%	1.00%	-9.70%	3.80%	-4.60%	-2.70%		-3.90%	6.10%
Yone				3.60%	4.60%	7.70%	5.10%		-2.40%	12.50%	
Jayce	5.20%										
Gangplank	-2.50%	-1.30%				1.40%	4.90%	-6.50%	-2.30%	-4.90%	
Gragas	12.50%	2.00%				-3.30%	2.70%	10.10%	8.50%		
Jax	-7%	-7.10%		-3.50%	5.50%				2.70%		
Aatrox	4.30%	-1.60%		-3.70%	2.40%			3.80%	2.50%		-5.90%
Flora		1.70%		5.60%	-6.90%	-2.90%	-3.60%		-3.70%	5.10%	
Ornn	-1.90%	4.00%		1.40%	-5.20%	-5.50%	-2.3	2.10%			
Gnar	4.50%	-8.10%		6.70%			2.90%	-4.00%			
Maokai	-7.60%						6.60%				
Gold diff of	Camille	Yone	Jayce	Gangplank	Gragas	Jax	Aatrox	Flora	Ornn	Gnar	Maokai
Camille		153		469		449	364				-297
Yone	-153			518	-173	413	340	376	-474		
Jayce						187			-177		
Gangplank	-469	-518				-627	281	-637	-483	-647	
Gragas		173				-192	645	219	201		
Jax	-449	-413		627	192						
Aatrox	-364	-340	-187	-281	-645				-584	-189	-1076
Flora		-376			-219				-474		
Ornn		474	177	483	-201		584	474		159	
Gnar				647			189		-159		
Maokai	297						1076				

Figure 4.2 The win rate and gold difference in 15 mins of blue champions fighting with green champions in top lane

win rate o	Galio	Ryze	Akali	Viktor	Azir	Lissandra	Sylas	Orianna	Ahri	Yone
Galio			-7.50%	3.60%			-3.70%			5.90%
Ryze			8.70%	10.30%						3.00%
Akali	7.20%	-3.30%						6.00%		
Viktor	-5.90%	-6.90%	1.40%			-3.60%	2.20%	5.10%		2.60%
Azir			7.20%	5.60%			5.90%		5.70%	8.40%
Lissandra				4.20%			1.70%		5.40%	2.70%
Sylas	3.00%	5.30%	2.30%	-1.30%	1.00%			-1.70%	-1.70%	
Orianna			-3.80%	-4.90%			3.40%			
Ahri						-4.30%	3.10%			-3.50%
Yone	-7.20%	1.40%	3.20%	-2.20%	-2.00%	-1.10%	2.60%		4.40%	
Gold diff i	Galio	Ryze	Akali	Viktor	Azir	Lissandra	Sylas	Orianna	Ahri	Yone
Galio				431						545
Ryze										231
Akali				-182					197	
Viktor	-431		182			-267				296
Azir										488
Lissandra				267						250
Sylas										365
Orianna										
Ahri			-197							
Yone	-545	-231		-296	-488	-250	-365			

Figure 4.3 The win rate and gold difference in 15 mins of blue champions fighting with green champions in middle lane

## 4.2 Min-Max Normalization of data

Using Min-Max normalization to normalize data:

Normalized	Camille	Yone	Jayce	Gangplank	Gragas	Jax	Aatrox	Flora	Ornn	Gnar	Maokai
Camille	0	0.112	-0.536	0.08	-0.776	0.304	-0.368	-0.216	0	-0.312	0.488
Yone	0	0	0	0.288	0.368	0.616	0.408	0	-0.192	1	0
Jayce	0.416	0	0	0	0	0	0	0	0	0	0
Gangplank	-0.2	-0.104	0	0	0	0.112	0.392	-0.52	-0.184	-0.392	0
Gragas	1	0.16	0	0	0	-0.264	0.216	0.808	0.68	0	0
Jax	-0.56	-0.568	0	-0.28	0.44	0	0	0	0.216	0	0
Aatrox	0.344	-0.128	0	-0.296	0.192	0	0	0.304	0.2	0	-0.472
Flora	0	0.136	0	0.448	-0.552	-0.232	-0.288	0	-0.296	0.408	0
Ornn	-0.152	0.32	0	0.112	-0.416	-0.44	-18.4	0.168	0	0	0
Gnar	0.36	-0.648	0	0.536	0	0	0.232	-0.32	0	0	0
Maokai	-0.608	0	0	0	0	0	0.528	0	0	0	0
Normalized	Camille	Yone	Jayce	Gangplank	Gragas	Jax	Aatrox	Flora	Ornn	Gnar	Maokai
Camille	0	0.142193	0	0.435874	0	0.417286	0.33829	0	0	0	-0.27602
Yone	-0.14219	0	0	0.481413	-0.16078	0.383829	0.315985	0.349442	-0.44052	0	0
Jayce	0	0	0	0	0	0	0.173792	0	-0.1645	0	0
Gangplank	-0.43587	-0.48141	0	0	0	-0.58271	0.261152	-0.59201	-0.44888	-0.6013	0
Gragas	0	0.160781	0	0	0	-0.17844	0.599442	0.203532	0.186803	0	0
Jax	-0.41729	-0.38383	0	0.582714	0.178439	0	0	0	0	0	0
Aatrox	-0.33829	-0.31599	-0.17379	-0.26115	-0.59944	0	0	0	-0.54275	-0.17565	-1
Flora	0	-0.34944	0	0	-0.20353	0	0	0	-0.44052	0	0
Ornn	0	0.44052	0.164498	0.448885	-0.1868	0	0.542751	0.44052	0	0.14777	0
Gnar	0	0	0	0.601301	0	0	0.175651	0	-0.14777	0	0
Maokai	0.276022	0	0	0	0	0	1	0	0	0	0

Figure 4.4 The normalized win rate and gold difference in 15 mins of blue champions fighting with green champions in top lane

Normalized win	Galio	Ryze	Akali	Viktor	Azir	Lissandra	Sylas	Orianna	Ahri	Yone
Galio	0	0	-0.72816	0.349515	0	0	-0.35922	0	0	0.572816
Ryze	0	0	0.84466	1	0	0	0	0	0	0.291262
Akali	0.699029	-0.32039	0	0	0	0	0	0.582524	0	0
Viktor	-0.57282	-0.6699	0.135922	0	0	-0.34951	0.213592	0.495146	0	0.252427
Azir	0	0	0.699029	0.543689	0	0	0.572816	0	0.553398	0.815534
Lissandra	0	0	0	0.407767	0	0	0.165049	0	0.524272	0.262136
Sylas	0.291262	0.514563	0.223301	-0.12621	0.097087	0	0	-0.16505	-0.16505	0
Orianna	0	0	-0.36893	-0.47573	0	0	0.330097	0	0	0
Ahri	0	0	0	0	0	-0.41748	0.300971	0	0	-0.33981
Yone	-0.69903	0.135922	0.31068	-0.21359	-0.19417	-0.1068	0.252427	0	0.427184	0
Normalized go	Galio	Ryze	Akali	Viktor	Azir	Lissandra	Sylas	Orianna	Ahri	Yone
Galio	0	0	0	0.790826	0	0	0	0	0	1
Ryze	0	0	0	0	0	0	0	0	0	0.423853
Akali	0	0	0	-0.33394	0	0	0	0	0.361468	0
Viktor	-0.79083	0	0.333945	0	0	-0.48991	0	0	0	0.543119
Azir	0	0	0	0	0	0	0	0	0	0.895413
Lissandra	0	0	0	0.489908	0	0	0	0	0	0.458716
Sylas	0	0	0	0	0	0	0	0	0	0.669725
Orianna	0	0	0	0	0	0	0	0	0	0
Ahri	0	0	-0.36147	0	0	0	0	0	0	0
Yone	-1	-0.42385	0	-0.54312	-0.89541	-0.45872	-0.66972	0	0	0

Figure 4.5 The normalized win rate and gold difference in 15 mins of blue champions fighting with green champions in middle lane

### 4.3 Marking system of counter relations

In order to figure out the quantify the counter relations of champions, a marking system is necessary. In the above process, we used two variables, namely, gold difference in 15 mins and win rate, but the weight of the two variables in the marking system is not the same. Although in the general theory, a champion counter another one refers to the economic will have a greater advantage, but because this data source is the ranking data of non-professional players, the ability of economy to suppress is lower than that of professional players. Therefore, we take the win rate as a supplementary factor. When this value is large enough, it will have a certain impact on the score of counter relations.

When the score is higher, it means that the champion has a stronger ability to suppress another champion, which helps the team to select the champion who can suppress the champion in the second hand when facing the opponent. But in the counter position selection, the marking system of counter relations is only one of the factors. And often in the team's decision-making, a player's high proficiency and confidence in a champion is also a factor of BP's decision.

The full marking system is:

$$[0.9 * (\text{normalized gold difference}) + 0.1 * (\text{normalized win rate})] * 100 = \text{Final score}$$

The absolute values of all the results are in the range [0,100], and the integers are reserved for easier observation.

According to the function above, we can calculate values by Excel:

Counter scores	Camille	Yone	Jayce	Gangplank	Gragas	Jax	Aatrox	Fiora	Ornn	Gnar	Maokai
Camille	0	14	-5	40	-8	41	27	-2	0	-3	-20
Yone	-13	0	0	46	-11	41	33	31	-42	10	0
Jayce	4	0	0	0	0	0	16	0	-15	0	0
Gangplank	-41	-44	0	0	0	-51	27	-58	-42	-58	0
Gragas	10	16	0	0	0	-19	56	26	24	0	0
Jax	-43	-40	0	50	20	0	0	0	2	0	0
Aatrox	-27	-30	-16	-26	-52	0	0	3	-47	-16	-95
Fiora	0	-30	0	4	-24	-2	-3	0	-43	4	0
Ornn	-2	43	15	42	-21	-4	-135	41	0	13	0
Gnar	4	-6	0	59	0	0	18	-3	-13	0	0
Maokai	19	0	0	0	0	0	95	0	0	0	0

Figure 4.5 The final scores of blue champions fighting with green champions in top lane

Counter scores	Galio	Ryze	Akali	Viktor	Azir	Lissandra	Sylas	Orianna	Ahri	Yone
Galio	0	0	-7	75	0	0	-4	0	0	96
Ryze	0	0	8	10	0	0	0	0	0	41
Akali	7	-3	0	-30	0	0	0	6	33	0
Viktor	-77	-7	31	0	0	-48	2	5	0	51
Azir	0	0	7	5	0	0	6	0	6	89
Lissandra	0	0	0	48	0	0	2	0	5	44
Sylas	3	5	2	-1	1	0	0	-2	-2	60
Orianna	0	0	-4	-5	0	0	3	0	0	0
Ahri	0	0	-33	0	0	-4	3	0	0	-3
Yone	-97	-37	3	-51	-83	-42	-58	0	4	0

Figure 4.5 The final scores of blue champions fighting with green champions in middle lane

## 5. An analysis of players' proficiency

Each player has a different level of mastery of each champion, as a result the performances of players when playing different champions differ widely. Furthermore, when making BP strategy, the proficiency of a champion is a vital factor to influence the result of a match. It is not only because whether members in your own team can pick the champions with high proficiency or not, but also because whether it is necessary to ban a champion that an opponent has high proficiency.

## 5.1 Collecting data is related to proficiency

This research collect data from *qwer.gg* when T1 and DRX players playing different champions before the final.

T1										
Champion	Wins	Loses	Win Rate	KDA	Kills	Deaths	Assists	DPM	DTPM	CSPM
Zeus										
Fiora	1	0	100.00%	11	4	1	7	640	983	8
Aatrox	1	0	100.00%	12	3	1	9	674	679	8
Jax	0	1	0.00%	1.25	0	4	5	358	753	6
Gangplank	2	0	100.00%	4.428571	14	7	17	1000.5	850	7.9
Jayne	2	0	100.00%	1.384615	3	13	15	772	629	7.8
Yone	3	0	100.00%	3.2	16	10	16	687.3333	658.6667	8.6
Camille	1	1	50.00%	2.857143	7	7	13	455	764	8
Gragas	1	0	100.00%	20	4	1	16	507	819	5.9
Oner										
Sejuani	4	0	100.00%	13.25	8	4	45	387.75	775.75	4.65
Viego	1	1	50.00%	6.125	16	8	33	375.25	801.75	5.1
Lee Sin	1	0	100.00%	2.25	1	4	8	169	885	6
Poppy	1	0	100.00%	4.5	2	2	7	255	666	5
Graves	1	0	100.00%	4.666667	4	3	10	406	612	8.4
Vi	0	1	0.00%	2.2	2	5	9	192	734	4.7
Nocturne	1	0	100.00%	3.25	5	4	8	374	834	5.5
Faker										
Akali	3	1	75.00%	4.066667	14	7.5	16.5	592	694	7.025
Viktor	2	0	100.00%	5.166667	9	6	22	858.5	411	7.75
Sylas	2	0	100.00%	2.166667	3.5	3	3	451.5	829.5	6
Lissandra	1	0	100.00%	9	0	1	9	278	497	8
Azir	1	0	100.00%	4.666667	3	3	11	795	474	8.2
Ryze	2	0	100.00%	3	7	6	11	590.5	614.5	8.8
Galio	0	1	0.00%	1.6	2	5	6	500	686	6.6
Gumayusi										
Sivir	2	0	100.00%	13.5	4.5	0	9	670.5	442	10
Kalista	1	0	100.00%	15	6	0	9	501	410	10
Kai'Sa	1	0	100.00%	15	11	0	4	704	275	11
Lucian	3	1	75.00%	5.555556	29	9	21	854	441.8125	10.2625
Aphelios	0	1	0%	0.75	1	4	2	439	463	9
Varus	2	0	100.00%	13.67	20	3	21	799.5	418	8.7
Xayah	1	0	100.00%	11	7	0	4	733	382	12
Ashe	1	0	100.00%	9	3	0	6	316	190	8.8
Keria										
Yuumi	2	0	100.00%	14	1.5	0	12.5	574.5	148	0
Alistar	1	0	100.00%	10	1	1	9	184	311	1
Thresh	0	1	0.00%	1.33	2	3	2	141	372	1
Soraka	1	0	100.00%	20	0	1	20	188	352	0
Nami	3	1	75.00%	9.666667	5	6	53	241.5625	321.9375	0.375
Tahm Ken	1	0	100.00%	17	1	1	16	254	553	1.5
Renata Gl	2	0	100.00%	18	4	2	32	191.5	253.5	0.65
Heimerdin	1	0	100.00%	4.5	0	2	9	223	192	0.7

Figure 5.1 T1 players play different champions before the final

DRX										
Champion	Wins	Losses	Win rate	KDA	Kills	Deaths	Assists	DPM	DTPM	CSPM
Kingen										
Aatrox	5	1	83.33%	4.583333	15	12	40	504.6667	729.6667	8.436923
Camille	3	1	75.00%	2.307692	13	13	17	487.75	773.5	9.418868
Sylas	1	0	100.00%	10	4	1	6	657	750	0.727273
Gnar	2	0	100.00%	5.333333	5	3	11	553	722	2.684211
Sejuani	0	1	0.00%	1	1	5	4	407	839	6
Maokai	0	1	0.00%	0.4	0	5	2	480	789	12.5
Ornn	2	0	100.00%	9.5	7	2	12	437	605	1.352381
Fiora	1	1	50.00%	3	5	3	4	381	777	4.914286
Gragas	2	0	100.00%	5.333333	3	3	13	403.5	600.5	2.036842
Pyosik										
Maokai	1	0	100.00%	13	2	1	11	345	523	0.214286
Sejuani	3	1	75.00%	5.714286	6	7	34	288.75	818.25	2.8
Graves	1	2	33.33%	2.857143	8	7	12	269.6667	633.6667	6.049254
Viego	3	0	100.00%	11.66667	13	3	22	345	706	1.192105
Vi	2	0	100.00%	11	4	2	18	285	611	0.916667
Kindred	4	0	100.00%	6.8	8	5	26	389	617.5	3.179487
Poppy		1	0.00%	6	1	1	5	240	1050	0.733333
Zeka										
Akali	4	2	66.67%	12.8	35	5	29	557.5	656.3333	4.366337
Sylas	7	0	100.00%	7	47	10	23	494.5714	681	7.95
Azir	2	2	50.00%	4	11	6	13	607.5	455	9
Yone	1	0	100.00%	11	7	1	4	938	704	0.916667
Orianna		1	0.00%	4	3	2	5	483	499	2.425
Ahri	1		100.00%	6	1	0	5	422	318	1.414286
Galio	1		100.00%	5.5	2	2	9	363	515	1.353846
Deft										
Miss Fortune	2	3	40.00%	3.727273	13	11	28	701.4	318	11.60573
Sivir	1	0	100.00%	10	2	1	8	771	390	0.909091
Tristana	2	0	100.00%	10.5	10	2	11	469	322.5	1.73913
Ezreal	2	1	66.67%	4.6	8	5	15	964	504.6667	5.772152
Caitlyn	3	0	100.00%	12.5	8	2	17	500.6667	411.3333	2
Ashe	2	1	66.67%	3.875	14	8	17	547.6667	393.3333	5.680734
Draven	1		100.00%	7	5	1	2	534	448	1.175
Kalista	1		100.00%	11	2	1	9	440	544	0.708333
Varus	2	0	100.00%	9	8	2	10	549.5	333	1.85
Beryl										
Yuumi	1	0	100.00%	12	1	1	11	612	77	0
Amumu	2	1	66.67%	3.888889	8	9	27	221.3333	383	0.658537
Tahm Kench	1	0	100.00%	6	0	0	6	82	277	0.142857
Rell	2	0	100.00%	3.25	0	4	13	99.5	267	0.470588
Heimerdinger	2	2	50.00%	2.538462	6	13	27	560.25	367	0.95443
Lux	2	0	100.00%	16	2	1	14	213.5	218.5	0.141176
Lulu	0	1	0.00%	0.666667	1	3	1	118	329	0
Braum	2	0	100.00%	14.5	2	2	27	200.5	364.5	0.129032
Soraka	1	1	50.00%	1.6	0	5	8	157	290	0.571429
Ashe	1		100.00%	4.333333	1	3	12	443	372	0.15
Karma	1		100.00%	14	0	1	14	334	286	0.053333
Renata Glasc	1		100.00%	7.5	0	2	15	225	386	0.070588

Figure 5.2 DRX players play different champions before the final

Variable interpretation:

Kills: The number of slamming enemies

Deaths: The number of being slammed by enemies

Assists: The number of secondary attacks

KDA= (Kills+Assists)/Deaths (When Deaths is equal to 0, then let it equals to 1 );

DPM: Damage to champions per minute;

DTPM: Damage taken per Minute;

CSPM: Creep Score per minute.

Now that there are stats for both teams in this competition, and the next step is to get a ranking of the players' proficiency with each champion. However, there are too many variables, so dimensionality reduction is required. Since the variables are correlated, for



example, KDA affects win rate and DPM. Therefore the research performed principal component analysis on these data to get the uncorrelated parts.

## 5.2 Principal component analysis (PCA)

Data, results and R-code used are released at <https://github.com/ISCLIN/LOL-BP-marking-system/tree/main>

The main steps in T1 players analysis:

(1) Start by importing the data into Rstudio, using the following variables:

Champion	Win rate	KDA	DPM	DTPM	CSPM
----------	----------	-----	-----	------	------

- (2) Use z-score normalization to normalize data
- (3) Calculate the correlation coefficient matrix
- (4) Solve the eigenvalues and corresponding eigenvectors
- (5) Extract the eigenvalues from the results and convert them to standard deviation
- (6) Calculate variance contribution rate and cumulative contribution rate
- (7) Draw scree graphs

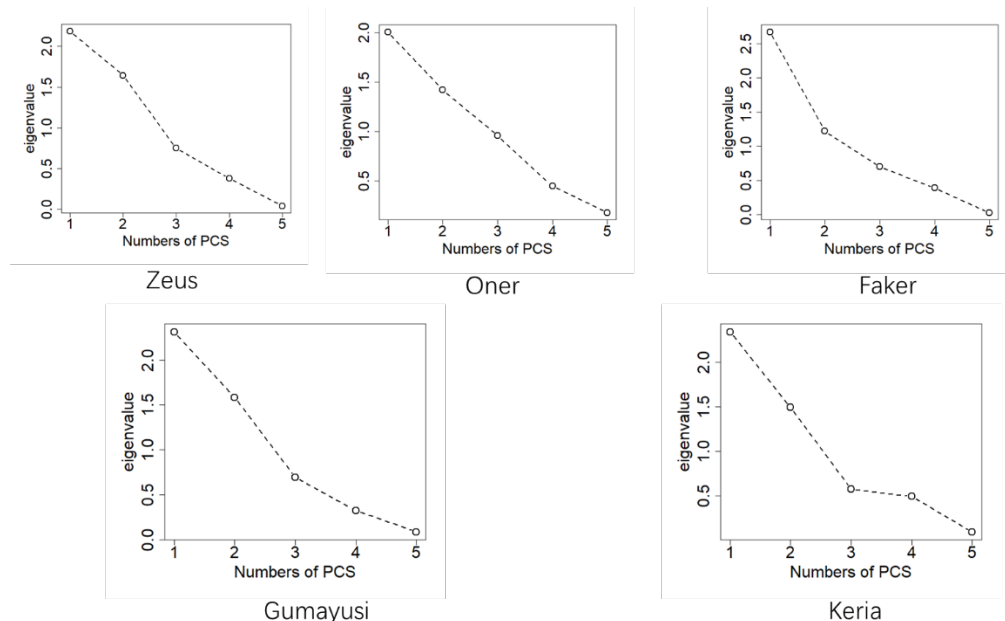


Figure 5.3 T1 players scree graphs

- (8) Extract the feature vector in the result
- (9) Perform matrix multiplication to obtain PC score

The results are:

```
(Proportion_of_Variance1 <- Zeus_data4/sum(Zeus_data4))
[1] 0.436992526 0.328410288 0.150089439 0.076263809 0.008243938
(Proportion_of_Variance2 <- Oner_data4/sum(Oner_data4))
[1] 0.40124036 0.28343133 0.19091298 0.08910470 0.03531064
(Proportion_of_Variance3 <- Faker_data4/sum(Faker_data4))
[1] 0.534106321 0.243581508 0.139442520 0.077663890 0.005205761
(Proportion_of_Variance4 <- Gumayusi_data4/sum(Gumayusi_data4))
[1] 0.46277035 0.31650557 0.13897116 0.06481034 0.01694258
(Proportion_of_Variance5 <- Keria_data4/sum(Keria_data4))
[1] 0.46904659 0.29886745 0.11477874 0.09898884 0.01831838

> (cumulative_Proportion1 <- cumsum(Proportion_of_Variance1))
[1] 0.4369925 0.7654028 0.9154923 0.9917561 1.0000000
> (cumulative_Proportion2 <- cumsum(Proportion_of_Variance2))
[1] 0.4012404 0.6846717 0.8755847 0.9646894 1.0000000
> (cumulative_Proportion3 <- cumsum(Proportion_of_Variance3))
[1] 0.5341063 0.7776878 0.9171303 0.9947942 1.0000000
> (cumulative_Proportion4 <- cumsum(Proportion_of_Variance4))
[1] 0.4627703 0.7792759 0.9182471 0.9830574 1.0000000
> (cumulative_Proportion5 <- cumsum(Proportion_of_Variance5))
[1] 0.4690466 0.7679140 0.8826928 0.9816816 1.0000000
```



Figure 5.4 T1 players variance and cumulative variance in PCA

And for DRX, the research use prcomp function to do PCA.

And the results are:

```
> summary(com1)
Importance of components:
              PC1      PC2      PC3      PC4      PC5
Standard deviation  1.7984  1.0589  0.65492  0.39020  0.25176
Proportion of Variance 0.6468  0.2243  0.08579  0.03045  0.01268
Cumulative Proportion 0.6468  0.8711  0.95687  0.98732  1.00000

> summary(com2)
Importance of components:
              PC1      PC2      PC3      PC4      PC5
Standard deviation  1.7360  1.2074  0.61662  0.34946  0.16158
Proportion of Variance 0.6027  0.2916  0.07604  0.02442  0.00522
Cumulative Proportion 0.6027  0.8943  0.97035  0.99478  1.00000

> summary(com3)
Importance of components:
              PC1      PC2      PC3      PC4      PC5
Standard deviation  1.513  1.0821  0.9173  0.67910  0.48607
Proportion of Variance 0.458  0.2342  0.1683  0.09224  0.04725
Cumulative Proportion 0.458  0.6922  0.8605  0.95275  1.00000

> summary(com4)
Importance of components:
              PC1      PC2      PC3      PC4      PC5
Standard deviation  1.7668  1.0634  0.7285  0.46079  0.06921
Proportion of Variance 0.6243  0.2262  0.1061  0.04247  0.00096
Cumulative Proportion 0.6243  0.8505  0.9566  0.99904  1.00000

> summary(com5)
Importance of components:
              PC1      PC2      PC3      PC4      PC5
Standard deviation  1.5163  1.0637  0.8906  0.70298  0.53114
Proportion of Variance 0.4598  0.2263  0.1586  0.09884  0.05642
Cumulative Proportion 0.4598  0.6861  0.8447  0.94358  1.00000
```

Figure 5.5 DRX players variance and cumulative variance in PCA

### 5.3 Scores

For the selection of K value, we regard the corresponding value of the dimension whose cumulative contribution rate reaches 85% as the K value, so we can obtain the K value of each team member:

Zeus	Oner	Faker	Gumayusi	Keria
3	3	3	3	3
Kingen	Pyosik	Zeka	Deft	BeryL
2	2	3	2	4

In order to unify the observations, we set the value of K to 3, that is to say, the values of PC1, PC2, and PC3 are retained.

In order to get the ranking, we need to get their vector lengths:

$$PC1^2 + PC2^2 + PC3^2 = PC_{Long}$$

Then we can figure out the final scores of proficiencies for each champion and each player:

Zeus		Gumayusi			Kingen		Deft	
Jax	9.573615	Aphelios	11.75232		Sylas	8.615525	Miss Fortune	12.24868
Gragas	7.208589	Ashe	7.678063		Maokai	7.292197	Ezreal	8.010373
Fiora	3.938801	Xayah	3.594401		Sejuani	6.211853	Kalista	5.554401
Gangplank	3.3422	Kai'Sa	2.759925		Ornn	5.987598	Tristana	2.97656
Jayce	2.603309	Varus	2.605445		Gragas	4.563786	Ashe	2.529154
Yone	2.445771	Lucian	2.293067		Fiora	1.817619	Caitlyn	2.308419
Camille	1.5531	Sivir	0.859056		Gnar	1.52293	Sivir	2.205551
Aatrox	1.376845	Kalista	0.596372		Camille	1.520802	Varus	1.562646
Oner		Keria			Pyosik		Beryl	
Graves	8.002476	Yuumi	9.057461		Poppy	9.475062	Yuumi	11.85115
Vi	6.46679	Thresh	9.028703		Graves	7.287973	Heimerdinger	9.385518
Sejuani	5.691385	Tahm Kench	7.139519		Maokai	4.442494	Lulu	8.281278
Lee Sin	4.411473	Soraka	3.193644		Kindred	3.439805	Lux	3.2801
Nocturne	0.835628	Renata Glasc	0.976992		Viego	1.929245	Amumu	2.847127
Viego	0.712515	Heimerdinger	0.93894		Vi	1.802693	Soraka	2.706175
Poppy	0.147274	Alistar	0.295529		Sejuani	0.73333	Braum	2.454834
Faker		Nami	0.263459		Zeka		Karma	2.279925
Galio	7.256138				Yone	7.318724	Renata Glasc	1.240675
Lissandra	7.023039				Orianna	4.759345	Tahm Kench	1.173618
Sylas	5.911582				Ahri	3.864036	Ashe	0.619561
Viktor	3.49669				Azir	3.31387	Rell	0.340805
Azir	2.68094				Sylas	2.69939		
Ryze	0.644628				Galio	1.969454		
Akali	0.500892				Akali	1.890504		

Figure 5.6 The final scores of proficiencies for each champion and each player

## 6. Overpower champions in the version of Word Champion

Due to the special nature of LOL, the changes of version have a significant impact on the strength of the champion. Finding overpower champions in the version of World Champion is a very important part for BP. Because due to the particularity of version champions, their stats will be higher than other champions and they can often achieve greater advantages in the match. Even if some players are not very proficient in these champions, they will be forced to use overpower champions in the real match. For how to find "Overpower champions", we can look to the BP rate of the World Champion from *qwer.gg*.

Champion	Pick	Rate
Sylas	49	3.84%
Azir	48	3.76%
Aatrox	46	3.61%
Aphelios	43	3.37%
Viego	38	2.98%
Sejuani	34	2.67%
Graves	33	2.59%
Akali	33	2.59%
Viktor	29	2.27%
Nami	28	2.20%
Leona	28	2.20%
Lucian	27	2.12%
Maokai	26	2.04%
Miss Fortune	25	1.96%
Kalista	25	1.96%
Gnar	25	1.96%
Kai'Sa	25	1.96%
Renata Glasc	24	1.88%
Fiora	24	1.88%
Varus	23	1.80%

Champion	Ban	Rate
Caitlyn	86	6.77%
Yuumi	85	6.69%
Aatrox	79	6.22%
Sejuani	57	4.48%
Graves	50	3.93%
Sylas	50	3.93%
Maokai	48	3.78%
Azir	43	3.38%
Kalista	43	3.38%
Akali	34	2.68%
Renekton	30	2.36%
LeBlanc	29	2.28%
Lucian	29	2.28%
Fiora	29	2.28%
Nautilus	24	1.89%
Ornn	24	1.89%
Renata Glasc	23	1.81%
Draven	22	1.73%
Aphelios	20	1.57%
Viktor	20	1.57%

Figure 6.1 The top 20 picked and banned heroes in the World Champion in 2022

Banning a champion means a team has no method to handle the champion, and when most teams choose to ban the champion, it means that the champion will put their team in trouble as soon as it is released. Compared with the pick of champions, the pick of a champion should not only consider whether the champion is an overpower champion, but also consider the impact of counter relations and players on the champion's proficiency. Therefore, the ban rate can affect the champion to become a overpower champion in this version more than the pick rate.

Therefore, there is an inequality:

$$\text{Ban rate} > \text{Pick rate}$$

Then we can set up the following equation for the overpower champion rating:

$$aB + bP = W \text{ (} W \text{ is the final score)}$$

In the equation above, a and b are the parameters of B (ban rate) and P (pick rate).

Assume  $b = 1$ , and let  $a = kb$  and  $kb > 1$ , the equation will be transformed:

$$kB + P = W$$

Then plug the data into this equation to get overpower champion score for each champion.

Champions	ban rate	pick rate	ban+pick
Aatrox	6.22%	3.61%	0.0983
Sylas	3.93%	3.84%	0.0777
Sejuani	4.48%	2.67%	0.0715
Azir	3.38%	3.76%	0.0714
Caitlyn	6.77%		0.0677
Yuumi	6.69%		0.0669
Graves	3.93%	2.59%	0.0652
Maokai	3.78%	2.04%	0.0582
Kalista	3.38%	1.96%	0.0534
Akali	2.68%	2.59%	0.0527
Aphelios	1.57%	3.37%	0.0494
Lucian	2.28%	2.12%	0.044
Fiora	2.28%	1.88%	0.0416
Viktor	1.57%	2.27%	0.0384
Renata Glasc	1.81%	1.88%	0.0369
Viego		2.98%	0.0298
Renekton	2.36%		0.0236
LeBlanc	2.28%		0.0228
Nami		2.20%	0.022
Leona		2.20%	0.022
Miss Fortune		1.96%	0.0196
Gnar		1.96%	0.0196
Kai'Sa		1.96%	0.0196
Nautilus	1.89%		0.0189
Ornn	1.89%		0.0189
Varus		1.80%	0.018
Draven	1.73%		0.0173

Figure 6.1 The ban rate, pick rate and ban+pick rate of champions

The fourth is the data of ban rate+pick rate. If the champion has only ban rate and ban+pick is greater than the following champions, then its rating is definitely higher than them. Because the general professional analysts choose 3% as the dividing limit of overpower champions, it can be obviously seen that Viego only has pick rate data and is lower than 0.03, so he is not an overpower champion. For Renekton below, he only has a ban rate and is lower than 0.03, we are not sure whether he meets the conditions.

For  $k$ , we already have a preliminary value range of  $(1, \infty)$  for  $k$ . Since the number of overpower champions is limited, it is generally 15-20. There are already 15 champions satisfying the condition above Viego, and if we count Draven in the last bit, it satisfies exactly 20, then the upper limit of  $k$  can be obtained:

$$1.73\% * k = 3\%$$

$$k_1 = 1.73$$

If Renakton is the last overpower, then at this point:

$$2.36\% * k = 3\%$$

$$k_2 = 1.27$$

Hence the probability of the fact that Renakton is an overpower champion is:

$$(k_1 - k_2) / (k_1 - 1) = 63.01\%$$

Since 63.01% (<95%) is not a high probability event, Renekton and all the following champions are not overpower champions.

Therefore, overpower champions for each position are found:

Champions	ban rate	pick rate	ban+pick
<b>Top</b>			
Aatrox	6.22%	3.61%	0.0983
Fiora	2.28%	1.88%	0.0416
<b>JUN</b>			
Sejuani	4.48%	2.67%	0.0715
Graves	3.93%	2.59%	0.0652
Maokai	3.78%	2.04%	0.0582
<b>MID</b>			
Sylas	3.93%	3.84%	0.0777
Azir	3.38%	3.76%	0.0714
Akali	2.68%	2.59%	0.0527
Viktor	1.57%	2.27%	0.0384
<b>ADC</b>			
Caitlyn	6.77%		0.0677
Kalista	3.38%	1.96%	0.0534
Aphelios	1.57%	3.37%	0.0494
Lucian	2.28%	2.12%	0.044
<b>SUP</b>			
Yuumi	6.69%		0.0669
Renata Glasc	1.81%	1.88%	0.0369

Figure 6.2 The overpower champions for each position

## 7. Combination of ADC and Sup

As we know, ADC and Sup are both in the bottom lane and the combinations of them in BP strategy are also important because some kinds of combination have more threat than casual combination of them. The data that displays ADC and Sup in the World Champion in 2022 can be collected at *gol.gg*. The supporters for each ADC in a match are ranked from top to bottom by time:

ADC	SUP	CSM1	CSM2	ADC	SUP	CSM1	CSM2	ADC	SUP	CSM1	CSM2	ADC	SUP	CSM1	CSM2	ADC	SUP	CSM1	CSM2
Mes Fortune	Amumu	8.8	1.1	Aphelios	Renata Glasc	10.2	1.2	Caitlyn	Lux	10	1.5	Lucian	Nami	10.2	0.6	Ashe	Heimerdini	9.7	0.9
	Amumu	10.6	1.1		Thresh	8.6	1.2		Braum	9.9	1.1		Nami	9	0.3		Heimerdini	9.2	1.4
	Leona	6.7	1.3		Leona	8.9	1.1		Lux	9.2	0.7		Nami	9.8	0.4		Heimerdini	8.8	0.7
	Lulu	10.4	0.4		Thresh	9.5	1		Lux	8.5	0.8		Nami	9.9	0.2		Heimerdini	7.8	1.1
	Yuumi	10.6	0.5		Tahm Kench	9.6	1.4		Lux	9.6	1.2		Nami	11.2	0.2	ADC	SUP	CSM1	CSM2
	Yuumi	10.3	0.2		Renata Glasc	9.4	0.5		Lux	9	1		Nami	10.7	0.4	Kalista	Renata Gla	7.3	0.3
	Soraka	9.9	0.6		Renata Glasc	8	0.6		Lux	9	1.4		Nami	9	0.2		Soraka	11	0.7
ADC	SUP	CSM1	CSM2		Leona	8.5	1.4	ADC	SUP	CSM1	CSM2		Nami	8.7	0.2		Renata Gla	9.4	0.5
Kai'Se	Rell	9.6	1		Soraka	9.9	0.6	Varus	Tahm Kench	7.8	1.1		Nami	9	0.6		Soraka	10	0.9
	Rell	10	1		Thresh	10.6	1.3		Tahm Kench	8.5	1.1		Nami	10.2	0.7		Renata Gla	8	0.9
	Amumu	10.5	1		Thresh	9.4	1.1		Renata Gla	9.2	0.8		Nami	8.5	0.3		Renata Gla	9	1.2
	Leona	8.2	1.5		Lulu	7.2	0.2		Tahm Kench	9.4	1.1		Nami	9.3	0.8		Renata Gla	9.7	0.6
	Heimerdini	6.6	0.6		Leona	8.5	1		Leona	9.2	1.1		Nami	10.1	0.3		Amumu	8.5	1.1
ADC	SUP	CSM1	CSM2		Lulu	5.9	0.8		Renata Gla	8.7	0.8		Nami	9.6	0.2		Soraka	9.6	0.5
Jhin	Leona	8.3	1.2		Renata Glasc	8.3	0.5		Leona	7.8	1.1		Nami	9.9	0.6		Renata Gla	9	0.5
	Karma	7.4	0.5		Lulu	10	0.6		Tahm Kench	9.3	1.5		Nami	8.6	0.2		Ashe	8.5	0.8
ADC	SUP	CSM1	CSM2		Lulu	8.6	0.3		Renata Gla	9.2	1.4		Nami	8.8	0.6	ADC	SUP	CSM1	CSM2
Sivir	Yuumi	9.9	0.1		Lulu	10.5	0.5		Renata Gla	8.1	0.8		Nami	8.8	0.4	Draven	Thresh	8.1	0.9
	Yuumi	9.7	0.1		Soraka	9	0.3		Tahm Kench	10.1	1.2		Nami	8.4	0.8		Renata Gla	7.8	0.6
	Yuumi	9.6	0.1		Lulu	9.3	0.5		Karma	9.3	0.4		Nami	8.7	0.2		Amumu	7.9	1.4
	Yuumi	11.2	0.4		Renata Glasc	10.4	0.4		Renata Gla	9.6	0.6		Nami	9	0.3		Soraka	9.4	0.6
	Yuumi	10.1	0.3		Lulu	10.4	0.2		Braum	8.9	1		Nami	9.2	0.2	ADC	SUP	CSM1	CSM2
	Yuumi	11.3	0.2		Lulu	10	0.7	ADC	SUP	CSM1	CSM2		Nami	10.3	0.3	Tristana	Rell	8	1.1
	Soraka	9.4	0.3		Lulu	10.5	0.5	Ezreal	Karma	9.7	0.6		Nami	10.3	0.6		Leona	8.8	1.3
ADC	SUP	CSM1	CSM2		Lulu	9.6	0.6		Heimerdini	9.8	0.8		Nami	10.5	0.6		Amumu	9.1	1.3
Xayah	Renata Gla	12	0.5		Lulu	9.5	0.4		Karma	10.6	0.8		Nami	10.3	0.4		Rell	10	1
					Lulu	8.1	0.6		Karma	10	0.5								

Figure 7.1 The supporters for each ADC

From the initial data, we can find that some champions are used too few times, so champions with less than 3 times of use need to be removed. The filtered data is as follows:

ADC	SUP	CSM1	CSM2	ADC	SUP	CSM1	CSM2	ADC	SUP	CSM1	CSM2	ADC	SUP	CSM1	CSM2	ADC	SUP	CSM1	CSM2
Miss Fortune	Amumu	8.8	1.1	Aphelios	Renata Gla	10.2	1.2	Caitlyn	Lux	10	1.5	Lucian	Nami	10.2	0.6	Ashe	Heimerdind	9.7	0.9
	Amumu	10.6	1.1		Thresh	8.6	1.2		Lux	9.2	0.7		Nami	9	0.3		Heimerdind	9.2	1.4
	Leona	6.7	1.3		Leona	8.9	1.1		Lux	8.5	0.8		Nami	9.8	0.4		Heimerdind	8.8	0.7
	Lulu	10.4	0.4		Thresh	9.5	1		Lux	9.6	1.2		Nami	9.9	0.2		Heimerdind	7.8	1.1
	Yuumi	10.6	0.5		Tahm Ken	9.6	1.4		Lux	9	1		Nami	11.2	0.2	ADC	SUP	CSM1	CSM2
	Yuumi	10.3	0.2		Renata Gla	9.4	0.5		Lux	9	1.4		Nami	10.7	0.4	Kalista	Renata Gla	7.3	0.3
	Soraka	9.9	0.6		Renata Gla	8	0.6	ADC	SUP	CSM1	CSM2		Nami	9	0.2		Soraka	11	0.7
ADC	SUP	CSM1	CSM2		Leona	8.5	1.4	Varus	Tahm Ken	7.8	1.1		Nami	8.7	0.2		Renata Gla	9.4	0.5
Kai'Sa	Rell	9.6	1		Soraka	9.9	0.6		Tahm Ken	8.5	1.1		Nami	9	0.6		Soraka	10	0.9
	Rell	10	1		Thresh	10.6	1.3		Renata Gla	9.2	0.8		Nami	10.2	0.7		Renata Gla	8	0.9
	Amumu	10.5	1		Thresh	9.4	1.1		Tahm Ken	9.4	1.1		Nami	8.5	0.3		Renata Gla	9	1.2
	Leona	8.2	1.5		Lulu	7.2	0.2		Leona	9.2	1.1		Nami	9.3	0.8		Renata Gla	9.7	0.6
	Heimerdind	6.6	0.6		Leona	8.5	1		Renata Gla	8.7	0.8		Nami	10.1	0.3		Amumu	8.5	1.1
ADC	SUP	CSM1	CSM2		Lulu	5.9	0.8		Leona	7.8	1.1		Nami	9.6	0.2		Soraka	9.6	0.5
Sivir	Yuumi	9.9	0.1		Renata Gla	8.3	0.5		Tahm Ken	9.3	1.5		Nami	9.9	0.6		Renata Gla	9	0.5
	Yuumi	9.7	0.1		Lulu	10	0.6		Renata Gla	9.2	1.4		Nami	8.6	0.2		Ashe	8.5	0.8
	Yuumi	9.6	0.1		Lulu	8.6	0.3		Renata Gla	8.1	0.8		Nami	8.8	0.6	ADC	SUP	CSM1	CSM2
	Yuumi	11.2	0.4		Lulu	10.5	0.5		Tahm Ken	10.1	1.2		Nami	8.8	0.4	Draven	Thresh	8.1	0.9
	Yuumi	10.1	0.3		Soraka	9	0.3		Karma	9.3	0.4		Nami	8.4	0.8		Renata Gla	7.8	0.6
	Yuumi	11.3	0.2		Lulu	9.3	0.5		Renata Gla	9.6	0.6		Nami	8.7	0.2		Amumu	7.9	1.4
	Soraka	9.4	0.3		Renata Gla	10.4	0.4	ADC	SUP	CSM1	CSM2		Nami	9	0.3		Soraka	9.4	0.6
					Lulu	10.4	0.2	Ezreal	Karma	9.7	0.6		Nami	9.2	0.2	ADC	SUP	CSM1	CSM2
					Lulu	10	0.7		Heimerdind	9.8	0.8		Nami	10.3	0.3	Tristana	Rell	8	1.1
					Lulu	10.5	0.5		Karma	10.6	0.8		Nami	10.3	0.6		Leona	8.8	1.3
					Lulu	9.6	0.6		Karma	10	0.5		Nami	10.5	0.6		Amumu	9.1	1.3
					Lulu	9.5	0.4						Nami	10.3	0.4		Rell	10	1
					Lulu	8.1	0.6												

Figure 7.2 The supporters for each ADC (Filtered)

From the data presented, it is obvious that some ADCs are basically paired with Supporters and cannot be split. The following definitions are made: when an ADC is fixed and the number of appearances of a Supporters accounts for more than 30%, they can become a usual bottom double; when an ADC only appears with the same supporter, and the supporter has hardly been paired with other ADCs, then they become a bound bottom double. Therefore, combinations in the bottom lane that meet the conditions are:

Usual Bottom Double		Using Rate	Bound Bottom Double		Using Rate
Kai'Sa	Rell	40%	Caitlyn	Lux	100%
Sivir	Yuumi	85.71%	Lucian	Nami	100%
Aphelios	Lulu	44.44%	Ashe	Heimerdinger	100%
Varus	Tahm Kench	38.46%			
	Renata Glasc	38.46%			
Ezreal	Karma	75%			
Tristana	Rell	50%			
Kalista	Renata Glasc	55.55%			

Figure 7.3 The usual and bound bottom double

Then at the same time, we can also get the rank of the bottom double lane pushing ability(CSM\_AVG is the average of CSM):

Bottom Double		CSM_AVG
Kai'Sa	Rell	10.8
Ezreal	Karma	10.73333
Sivir	Yuumi	10.5
Caitlyn	Lux	10.31667
Varus	Tahm Kench	10.22
Tristana	Rell	10.05
Lucian	Nami	9.946154
Ashe	Heimerdind	9.9
Varus	Renata Gla	9.84
Aphelios	Lulu	9.625
Kalista	Renata Gla	9.4

Figure 7.4 The rank of the bottom double lane pushing ability

## 8. Marking system of ban and pick in the final of World Champion

At first, the data has been collected is displayed:

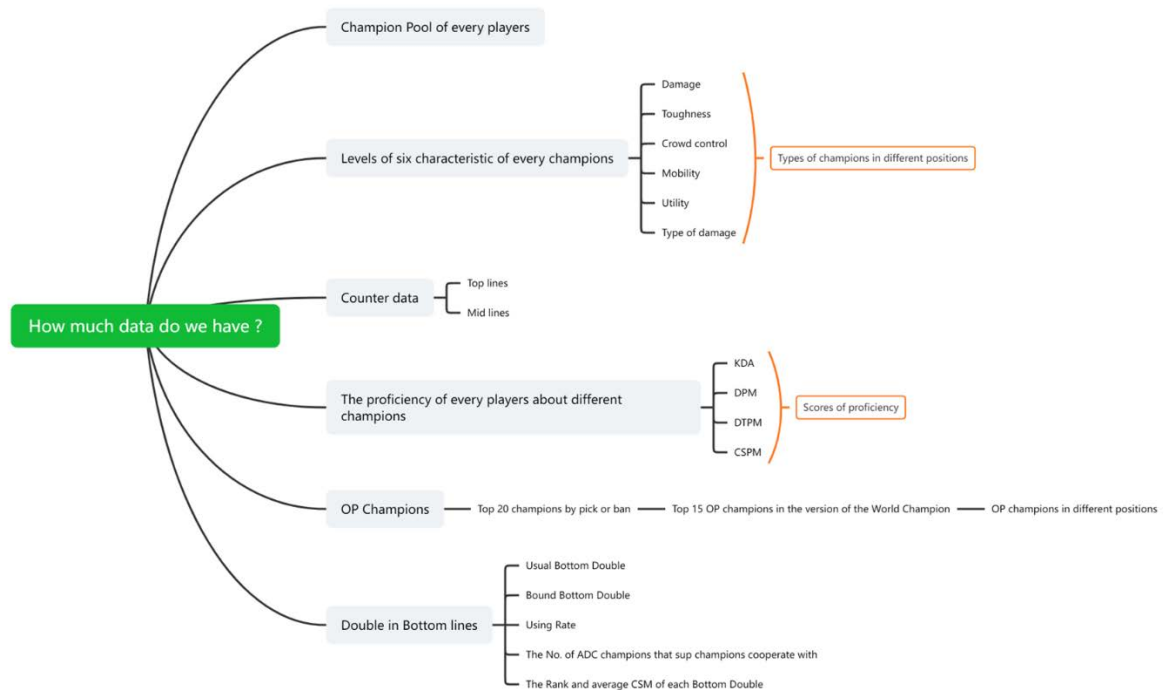


Figure 8.1 How much data do we have

### 8.1 Preparations

Now that the preparation has been completed, then the comprehensive marking system of BP will be set up. First, the research will list the marking factors of BP and set the variables:

1	Whether champions picked by the team follows the rules of rational combination	x	6	Whether champions picked by bottom double are usual or bound bottom double champions	a
2	Middle line counter	y	7	The ability of getting advantage in the bottom line (Average CSM)	b
3	Top line counter	z	8	How many OP champions the team bans	c
4	Proficiency of players about the champion	m	9	How many champions that opponents have a high level of proficiency with the team bans	d
5	How many champions picked by the team are OP champions	n			

There are 9 factors of the marking system, so the initial marking system can be built as:

$$\bullet \quad k_1x + k_2y + k_3z + k_4m + k_5n + k_6a + k_7b + k_8c + k_9d = S$$

S is the final score and k1-k7 are parameters of each variable. As can be seen from the previous procedure, these variables are independent of each other. Then the value range of the variable can be defined:

x	0-2(according to the No. of rules they followed)	a	0(neither) 1(usual) 2(bound)
y	0(be countered) 1(neither) 2(counter)	b	9.4- 10.8(according to the CSM_AVG)
z	0(be countered) 1(neither) 2(counter)	c	0-5(according to the NO. of OP champions are banned)
m	0-13(according to the proficiency scores)	d	0-5(according to the NO. of champions that opponents have a high level of proficiency are banned)
n	0-5(according to the NO. of OP champions are picked)		

After that, assign an interval score to the value of the variable:



<b>x</b>	0-2(according to the No. of rules they followed)	0(x=0) 5(x=1) 10(x=2)	<b>a</b>	0(neither) 1(usual) 2(bound)	0(a=0) 5(a=1) 10(a=10)
<b>y</b>	0(be countered) 1(neither) 2(counter)	0(y=0) 5(y=1) 10(y=2)	<b>b</b>	9.4-10.8(according to the CSM_AVG)	0(b ∈ [9.4,9.63]) 2(b ∈ (9.63,9.86]) 4(b ∈ (9.86,10.09]) 6(b ∈ (10.09,10.32]) 8(b ∈ (10.32,10.55]) 10(b ∈ (10.55,10.8])
<b>z</b>	0(be countered) 1(neither) 2(counter)	0(z=0) 5(z=1) 10(z=2)	<b>c</b>	0-5(according to the NO. of OP champions are banned)	0(c=0) 2(c=1) 4(c=2) 6(c=3) 8(c=4) 10(c=5)
<b>m</b>	0-13(according to the proficiency scores)	0(m ∈ [0,2.17]) 2(m ∈ (2.17,4.34]) 4(m ∈ (4.34,6.51]) 6(m ∈ (6.51,8.68]) 8(m ∈ (8.68,10.85]) 10(m ∈ (10.85,13])	<b>d</b>	0-5(according to the NO. of champions that opponents have a high level of proficiency are banned)	0(d=0) 2(d=1) 4(d=2) 6(d=3) 8(d=4) 10(d=5)
<b>n</b>	0-5(according to the NO. of OP champions are picked)	0(n=0) 2(n=1) 4(n=2) 6(n=3) 8(n=4) 10(n=5)			

Furthermore, we need to determine the weight of each indicator (variable), and the entropy method is adopted in this study. It is necessary to use numerous data to train the model first, hence the data set from <https://www.kaggle.com/datasets/ezalos/lol-victory-prediction-from-champion-selection> is collected. Data involved in the data set is source from Riot Developer API and it includes rank matchups for players above the global diamond rank of over 80k.

The complete R-codes, data set and results can be found at: <https://github.com/ISCLIN/LOL-BP-marking-system/tree/main>

## 8.2 The steps of the whole process

- (1) First, importing the data of Training set into R, and the imported variables are as follows:

gameId	gameDuration	teamVictory
Player_1_ban	Player_1_pick	Player_1_position

(From player1-player10)

- (2) Select matches with gameDuration below 900s (15min) to ensure all matches are valid.
- (3) Since the advantage of counter relations are not obvious in a Rank game, because players are not as proficient with champions as the pros. And for the values of y, z, m and d, they are difficult to obtain. However, due to the large amount of data, these values will approach the mean value, so randomly assign values to the four variables y, z, m and d is feasible. The range of assigning values is the mean value of these variables, and the standard deviation is the normal distributed random value of the mean divided by 10.

- (4) Then calculate values of  $n$ ,  $a$ ,  $b$ ,  $c$  and  $x$ .
- (5) Data uniformization. Since these indicators are all positive indicators, only one side can be done.
- (6) Turn each element of the matrix generated in the previous step into the product of each element with the natural log (element) and calculate the information entropy.
- (7) Establish marking function.
- (8) Then, the function was substituted into the final match of T1 vs DRX. In this match, BO5 (three out of five sets) was played, and the two teams finally played all 5 games and DRX won. Their BP and winner of each game are shown in the table below:

1 set (T1 win)					
t1	pick	ban	DRX	pick	ban
Zeus	Yone	Ashe	Kingen	Aatrox	Ryze
Oner	Lee Sin	Ezreal	Pyosik	Viego	Caitlyn
Faker	Azir	Akali	Zeka	Sylas	Graves
Gumayusi	Varus	Sejuani	Deft	Sivir	Lucian
Keria	Renata Glasc	Rell	BeryL	Heimerdinger	Yummi
2 set (DRX win)					
t1	pick	ban	DRX	pick	ban
Zeus	Aatrox	Caitlyn	Kingen	Camille	Ryze
Oner	Graves	Akali	Pyosik	Viego	Nocturne
Faker	Viktor	Kindred	Zeka	Sylas	Lucian
Gumayusi	Ashe	Sejuani	Deft	Varus	Azir
Keria	Lux	Yummi	BeryL	Heimerdinger	Renata Glasc
3 set (T1 win)					
t1	pick	ban	DRX	pick	ban
Zeus	Gragas	Ashe	Kingen	Ornn	Caitlyn
Oner	Graves	Akali	Pyosik	Viego	Lee Sin
Faker	Azir	Sejuani	Zeka	Sylas	Lucian
Gumayusi	Varus	Kindred	Deft	Kalista	Yummi
Keria	Karma	Aatrox	BeryL	Renata Glasc	Yone
4 set (DRX win)					
t1	pick	ban	DRX	pick	ban
Zeus	Fiona	Caitlyn	Kingen	Aatrox	Ryze
Oner	Sejuani	Heimerdinger	Pyosik	Maokai	Ashe
Faker	Akali	Kindred	Zeka	Azir	Viktor
Gumayusi	Kalista	Viego	Deft	Varus	Lucian
Keria	Soraka	Yummi	BeryL	Renata Glasc	Yone
5 set (DRX win)					
t1	pick	ban	DRX	pick	ban
Zeus	Gwan	Heimerdinger	Kingen	Aatrox	Lee Sin
Oner	Viego	Akali	Pyosik	Hecarim	Lux
Faker	Viktor	Sejuani	Zeka	Azir	Lucian
Gumayusi	Varus	Kindred	Deft	Caitlyn	Yummi
Keria	Karma	Renata Glasc	BeryL	Bard	Yone

- (9) Substitute the variable value into the marking system to obtain the result:

1 set (T1 win)											
	x	y	z	m	n	a	b	c	d		Final score
T1		5	10	0	2	4	5	2	4	8	4.270032
DRX		10	0	10	2	4	0	8	8	6	2.990362
2 set (DRX win)											
	x	y	z	m	n	a	b	c	d		Final score
T1		10	0	10	2	6	0	4	8	10	1.821627
DRX		5	10	0	2	2	0	2	6	4	1.425052
3 set (T1 win)											
	x	y	z	m	n	a	b	c	d		Final score
T1		10	10	0	2	4	0	2	6	8	4.229829
DRX		10	0	10	2	4	5	0	6	8	4.229829
4 set (DRX win)											
	x	y	z	m	n	a	b	c	d		Final score
T1		10	10	10	2	6	0	0	4	10	1.600062
DRX		10	0	0	2	8	5	2	4	8	4.87567
5 set (DRX win)											
	x	y	z	m	n	a	b	c	d		Final score
T1		5	10	5	0	2	0	2	6	10	1.461075
DRX		10	0	5	0	6	0	6	4	8	2.500326

### 8.3 Results analysis

BP scores do not determine the outcome of the game, they are only one of the factors that affect the outcome of the game. The BP scores of these five games can be explained by the economic curve (qwer.gg) during the whole sets:

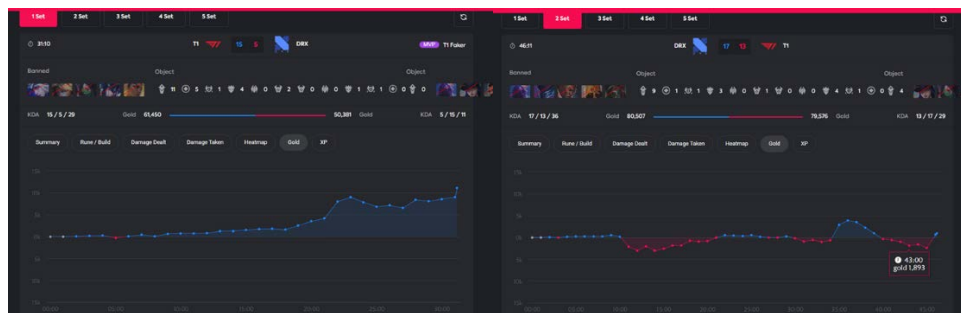


Figure 8.2 Economic curve of 1 set and 2 set

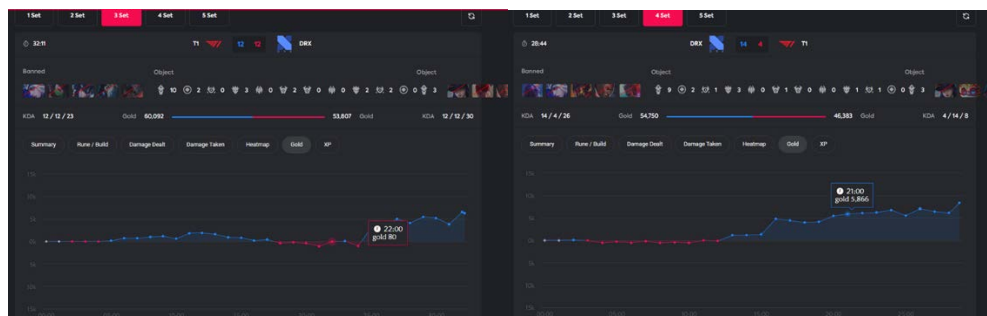


Figure 8.3 Economic curve of 3 set and 4 set

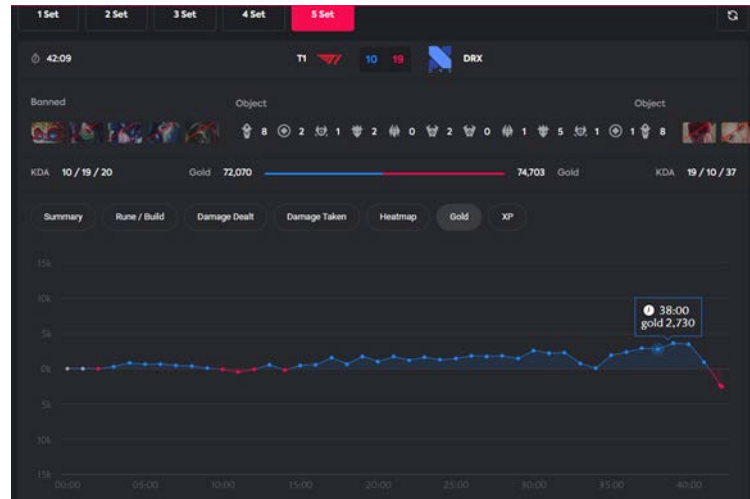


Figure 8.4 Economic curve of 5 set

In set 1 and set 3, T1 wins. In the economic curve of Set 1, the economic difference between T1 and DRX increases almost linearly without any fluctuations, which is largely related to the larger BP score of T1, because T1 can choose the middle of the champion pick to overwhelm the opponent's champion. So that the champion can get the advantage of the lane, and it can better radiate to the other lanes, obtain more resources, and then obtain the victory of the group battle. However, T1's BP score is lower than that of DRX in 3 sets, so their advantage on the lanes is not particularly obvious. And they are even surpassed by DRX in the middle period, which is because DRX picks the bottom double that is usual bottom double in the bottom lane and can obtain more lane advantages.

In 2,4, and 5 sets, DRX wins. In the economic curve of 2 set, DRX is almost worse than T1 in the early stage, which is largely related to the fact that the BP score of DRX is lower than that of T1. The lack of tanks in the BP of DRX makes it impossible for them to gain advantages over T1 with the tanks that can fight damage and control in the early small team fight. However, as there are many factors that affect the result of the match in the official game, DRX finally reverses to complete the upset. In the 4 set economic curve, it can be seen that DRX gains a slight advantage in the first 15 minutes, and in the end, due to their picks of more overpower champions and the higher efficiency of the CSM, they are able to use this advantage to snowball their way to victory. In the 5 set, many of the champions picked by the two teams are not the champions they picked in the previous, so it is hard to estimate the proficiency factor. But because DRX picked Aatrox which is overpower champion on the top lane, it can push a tower early to support other lanes earlier. The economy of two teams in the middle gained the lead because T1 stole a dragon from DRX, but the disadvantage of the BP in the final team fight was highlighted. No one could deal with the Aatrox, and T1 finally lost the final team fight.

## **9. Advantages and disadvantages**

### **9.1 Advantages**

In this project, through the analysis of a total of 9 influencing factors such as champion pool, overpower champions and so on, the BP marking system was finally established. The factors included in this system are basically complete, which can reflect the advantages and disadvantages of each team's BP and can give a quantitative score of the response. Moreover, the project is based on a large number of data, and the obtained parameters are real and credible.

### **9.2 Disadvantages**

This project has only verified one game, and the marking system should be applied to more games to improve the system. Moreover, the system does not take into account the special features of BO5 and BO1, because BO5 needs to take more account of the BP of the previous set, while BO1 does not need to take this into account.