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Analysis of Influential Factors of Tourism Economic Development in Hunan Province Based on Econometric Modeling

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Abstract:

Based on the data from 2000-2020, this study constructs a multiple linear regression model to analyze the influence of seven factors on Hunan tourism economy. The results show that the number of tourists received, the number of cultural and tourism facilities (performing arts groups + museums) are significantly positively correlated with the tourism economy, and the number of 5A scenic areas is negatively correlated. Through stepwise regression and multiple covariance test, it is found that the elasticity coefficients of the number of tourists and cultural and tourism facilities (performing arts groups + museums) on tourism income are 0.89 and 0.67 respectively, while the number of 5A scenic spots shows a negative effect of -0.23. The study puts forward targeted recommendations: 1. for the enhancement of tourists, it is recommended to innovate tourism products, strengthen precise marketing, and improve the transportation network to build an overall tourism pattern; 2. for the optimization of cultural and tourism facilities, it is necessary to dig deep into the cultural connotations of Hunan and Xiang, promote the integration of traditional culture and modern art, and improve the incentive mechanism for talent cultivation; 3. for the structural contradiction of 5A scenic spots, it is suggested that the implementation of the "quality first" policy reforms to promote the innovation of operation mode, and the technical monitoring and control of the operation mode. Promote the innovation of operation mode, and optimize the tourist experience and revenue distribution mechanism through technical monitoring. The study provides decision-making reference for Hunan tourism supply-side reform, and helps the tourism industry to develop in a high-quality and sustainable way.

Keywords: Eviews model, multiple linear regression model, tourism economy, Hunan Province

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1. Introduction

2. Overview of Tourism Development in Hunan Province

2.1 Characteristics of Tourism Development in Hunan Province

Hunan Province has unique advantages in terms of geographic location, education, history, literati, media publicity, entertainment, food and living atmosphere, etc. It is a good place full of charm and fireworks. Tourism has a strong attraction energy, has a good long-term development prospects, the development of tourism is its second choice [1].

2.2 Current situation of tourism development in Hunan Province

Hunan Province, relying on the "one belt, one" location advantages, build up the "seven vertical and seven horizontal" highway network and "five vertical and five horizontal" railroad network, the formation of three-dimensional transportation system radiating across the country, laying a solid foundation for the development of tourism. 2024 tourism industry to achieve historic breakthroughs: the annual reception of tourists more than 700 million, the total income of the tourism industry exceeded 1 trillion yuan, becoming the province's fourth trillion dollar industry. The brand building is remarkable, Yuelu Mountain, Orange Island, Shorzhai, Eighteen Caves, Dezhaan Grand Canyon are selected as "Top 100 National 5A Scenic Spots in 2024", and traditional scenic spots such as Zhangjiajie Wulingyuan continue to maintain a high level of heat. The characteristics of urban culture and tourism are distinctive, with Changsha forming a phenomenal attraction by virtue of the "Netflix economy + night consumption" model, Chenzhou creating IPs such as the Lin Dan Cup and marathon through "sports + tourism", and Hengyang upgrading its industry with the help of the Provincial Tourism Development Conference. The integration of culture and tourism is further promoted, Changsha Museum, Yuelu Academy and other cultural landmarks to carry out innovative study activities, flower-drum opera "New Liu Hai Chopping Woodcutter" and other performing arts products have become a phenomenal hit [2].

However, the development is still facing three major challenges: first, some scenic spots are lagging behind in service management, and the quality of catering and accommodation varies.

3. Analysis of model variables

Due to its own uncertainty, the tourism industry is very susceptible to the influence of season, time and other factors. Here, the level of total domestic tourism revenue in Hunan Province is selected to measure the level of tourism economic development in Hunan Province, and seven factors such as the total number of tourists received in Hunan Province are selected as the object of research in view of the characteristics of tourism development in Hunan Province.

3.1 Explained Variables

Selecting domestic tourism revenue as the explanatory variable can reduce the influence of exchange rates between different countries and regions and political and economic factors on the data in international tourism revenue. Domestic tourism revenue is mainly affected by domestic economy, policies and market environment, which is conducive to analysis and interpretation. Therefore, this paper chooses the index of "total domestic tourism revenue of Hunan Province" as the explanatory variable from 2000 to 2020.

3.2 Explanatory variables

3.2.1 The number of domestic tourists in Hunan Province (ten thousand). The total number of domestic tourists received by each scenic spot in the province during the statistical year, which directly reflects the scale of the tourism market. This indicator reflects the attractiveness of tourism products and the ability to expand the source market, which is the basic driving factor of tourism revenue [3].

3.2.2 The sum of performing arts organizations and museums in Hunan Province (number). The number of performing arts groups and the number of museums in Hunan Province are added together as an indicator of cultural resource supply. Performing arts groups convey the cultural connotations of Hunan through their special performances, while museums carry the function of displaying history and culture, which together constitute the core carrier of cultural experience tourism resources.

3.2.3 Transportation mileage (km). Integrating the total mileage of the three types of transportation networks, namely highways, railroads and inland waterways, reflecting the accessibility of the region. This indicator measures the accessibility of tourist destinations, which is an infrastructure element to support the development of regional tourism, and has a significant impact on the market of casual tourism and self-driving tourism [4].

3.2.4 Number of star-rated hotels (homes): statistics on the total number of star-rated hotels within the province, characterizing the quality of tourism reception facilities. Star-rated hotels enhance tourists' experience through standardized service system, and their number and scale are positively correlated with tourists' stay time and secondary consumption.

3.2.5 Disposable income per capita (yuan): Hunan Province's disposable income per capita data are used to measure residents' consumption capacity. This indicator directly affects tourists' tourism consumption willingness and consumption structure, and is a key variable driving the demand for high-end tourism products [5].

3.2.6 Gross domestic product (billion yuan). The annual GDP of Hunan Province is used as an indicator of the level of regional economic development, and GDP growth is usually accompanied by the improvement of residents' income, consumption upgrading and infrastructure improvement, which has a systematic supporting effect on the development of tourism [6].

3.2.7 Number of 5A-level scenic spots in Hunan Province. Statistics on the number of national 5A tourist attractions in Hunan Province, characterizing the top tourism resource endowment. 5A scenic spots as a representative of the regional tourism image, the number of which reflects the quality of the core attraction, but it should be noted that its non-linear relationship with tourism revenue may stem from market competition or differences in management efficiency.

4. Model Analysis

4.1 Model Establishment

In econometrics, the overall regression function used to describe the linear relationship between an explanatory variable and multiple explanatory variables is the multiple linear regression function. When studying the factors of tourism economic development in Hunan Province, there has been more than one explanatory variable, so the following multiple linear regression function is initially established:

$$Y=\beta0+\beta1\ X1+\beta2\ X2+\beta3\ X3+\beta4\ X4+\beta5\ X5+\beta6\ X6+\beta7\ X7+u. \quad (1)$$

4.2 Data collection and organization

Table 1 Hunan 2000-2020 tourism related data

Year	Gross Domestic Tourism Revenue in Hunan Province(billion yuan)	Total number of tourists received in Hunan Province (10,000)	Number of performing arts groups and museums in Hunan Province	Transportation mileage (including highway, railroad, inland waterway) (kilometers)	Number of hotels with star rating or above (home)	Per capital disposable income (yuan)	Gross Domestic Product (billion yuan)	Hunan Province 5A Number of scenic spots (number)
	Y	X1	X2	X3	X4	X5	X6	X7
2000	148.76	4695	162	73813	212	3721.3	100280.1	0
2001	210.50	5036	159	79528	270	4070.4	110863.1	0
2002	245.98	5757	161	97678	321	4531.6	121717.4	0
2003	294.11	5970	159	99972	359	5006.69	137422.0	0
2004	371.56	6487	162	102617	417	5660.9	161840.2	0
2005	453.62	7181	164	102970	388	6384.73	187318.9	0
2006	588.41	9195	166	186622	501	7228.82	219438.5	0
2007	732.71	10897	169	189612	585	8583.54	270092.3	2

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2008	851.75	12830	172	198761	569	9956.51	319244.6	2
2009	1099.47	16065	185	207066	567	10977.5	348517.7	2
2010	1425.80	20398	282	243661	549	12519.51	412119.3	2
2011	1785.78	25328	199	247851	568	14550.75	487940.2	4
2012	2234.10	30506	236	249844	581	16509.55	538580.0	5
2013	2681.86	36058	330	251392	587	18310.76	592963.2	5
2014	3050.70	41203	380	252750	555	20167.12	643563.1	6
2015	3712.91	47331	386	253375	498	21966.19	688858.2	7
2016	4707.43	56548	554	254957	461	23820.98	746395.1	8
2017	7172.62	66935	654	256389	407	25973.79	832035.9	8
2018	8355.73	75301	631	257098	397	28228.05	919281.1	8
2019	9762.32	83154	692	258113	315	30732.85	986515.2	9
2020	8261.95	69336	753	258752	320	32188.84	1015986.2	10

Data from Hunan Provincial Statistical Yearbook and Hunan Provincial Tourism Bureau.

4.3 Estimation of regression parameters

In this paper, the results of OLS regression estimation of Table 1 using Eviews software (see Table 2).

The estimated equation is obtained:

$Y=-218.7704+0.079463X_1+3.163279X_2-0.009353X_3-0.818724X_4-0.389657X_5+0.019490X_6-429.3240X_7$

(778.50)(0.03) (2.79) (0.01) (2.46) (0.43) (0.01) (192.72)

t=(-0.28) (2.85) (1.14) (-1.26) (-0.33) (-0.91) (1.55) (-2.23)

$R^2=0.99$ F=166.54 DW=1.30 n=21

Table 2 OLS regression estimation results

Variable	Coemcient	Std.Error	Std.Error	Prob
C	-218.7704	778.5045	-0.281014	0.7831
X1	0.079463	0.027839	2.854389	0.0135
X2	3.163279	2.786243	1.135321	0.2767
X3	-0.009353	0.007445	-1.256147	0.2312
X4	-0.818724	2.464988	-0.332141	0.7451
X5	-0.389657	0.426843	-0.912882	0.3779
X6	0.019490	0.012602	1.546569	0.1460
X7	-429.3240	192.7168	-2.227746	0.0442
R-squared	0.988972	Mean dependent var		2768.956
Adjusted R-squared	0.983034	S.D.dependent var		3080.994

S.E.of Regression	401.3153	Akaike info criterion	15.10970
Sum squared resid	2093701	Schwarz criterion	15.50762
Log likelihood	-150.6519	Hannan-auinn criter.	15.19606
F-statistic	166.5430	Durbin-Watson stat	1.304781
Prob(F statistic)	0.000000		

4.4 Tests and corrections of the model

4.4.1 Economic significance test

The model shows that tourism revenue in Hunan Province is positively correlated with the number of tourists received (X1, +0.0795 billion/million people), the number of cultural and tourism facilities (X2, +316.33 million/home), and GDP (X6, +0.0195 billion/billion yuan), and negatively correlated with the mileage of transportation (X3, -0.0094 billion/kilometer), the number of star-rated hotels (X4, -0.818.7 million/home), the income of residents (X5, -0.03897 billion/yuan), and the number of 5A scenic spots (X7, -42.9324 billion/unit) are negatively correlated. Negative coefficients transportation mileage macro-level measurement bias, statistical mileage fails to reflect the actual accessibility of tourists, and there is a revenue lag effect of transportation infrastructure. At the micro level, supporting services are lagging behind, and transportation improvements have not been synchronized to improve the quality of employees and service quality, leading to a decline in the tourist experience. The number of star-rated hotels on the macro level, there is a scale of diseconomies, the expansion of the number of hotels accompanied by a decline in the quality of service; micro-level structural surplus, the new hotels caught in the price war, the decline in occupancy rate dragged down the revenue, and the excessive concentration of high-star hotels in popular scenic spots exacerbate internal competition. The per capita disposable income of residents has exposed the imbalance of product structure on the macro level, Hunan tourism is overly reliant on traditional tourist attractions (low unit price and strong seasonality), and after the rise of residents' incomes, the high-end source of tourists flowed to the specialty IPs in the neighboring provinces. the micro level reflects the deviation of the policy orientation, and the strategy of strengthening the province through industry has led to the lagging of investment in tourism infrastructure and marketing behind the growth of revenues. the number of 5A scenic spots has fallen into the "entrance fee economy" on the macro level. The number of 5A scenic spots on the macro level is caught in the trap of "ticket economy", Hunan 5A scenic spots account for 58% of the ticket revenue (41% nationwide), and only 32% of the secondary consumption (Disney 80%). Micro-level diminishing marginal benefits, 2015-2020 5A scenic area number growth of 42.8%, but tourism revenue growth rate from 18.6% to 15.4%. There is a performance-oriented bias in the policy logic, local governments emphasize declaration but not operation, and the maintenance cost squeezes the funds for service improvement after renovation and investment [7].

4.4.2 Statistical Inference Test

4.4.2 .1 Goodness-of-fit test

From the data in Table 2, we can get R2 = 0.988972, and the modified decidable coefficient is R2 = 0.983034, which indicates that the model fits the sample well.

4.4.2 .2. F-value test

In this paper, for H0:β1 =β2 =β3 =β4 =β5 =β6 =β7 =0, given the significance level a=0.05, the critical value of F0.05(6, 15)=2.92 for degrees of freedom k-1=6 and n-k=15 is found in the F distribution table.From Table 2, F=166.5430> F0.05(6, 15)=2.79, so the original hypothesis, indicating that the regression equation is significant.

4.4.2 .3. t test

In this paper, for H0: βj = 0 (j = 0, 1, 2, 3, 4, 5, 6, 7), respectively, if given the significance level a = 0.05, check the t-distribution table to get the critical value of t0.05/2(15) = 2.131 for the degree of freedom of n-k = 15. From the data, it can be obtained that the t-statistic of X2, X3, X4, X5, and X6 are less than the critical value of 2.131, and should be accepted as the original hypothesis. , the effect on the explanatory variables is not significant, indicating that there is a serious multicollinearity in the model.

4.4.3 Tests and corrections

4.4.3 .1 Test

Based on the above tests of F and t, it shows that there is a serious multicollinearity in the model.

4.4.3 .2 Correction

In this paper, the stepwise regression method is used to

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correct the multicollinearity .
Firstly, a simple regression is done with each explanatory variable on the dissolved variables separately.
$Y=-710.6966+0.114856X_1$
(-3.46)(22.21) $R^2=0.9629$ F=493.5061 n=21
$Y=-1900.023+14.51281X_2$
(-6.68)(19.40) $R^2=0.95$ F=376.46 n=21
$Y=-3007.727+0.029424X_3$
(-1.98)(4.03)$R^2=0.46$ F=16.26 n=21
$Y=4898.772-4.744472X_4$
(1.80)(-0.81)$R^2=0.033$ F=0.65 n=21
$Y=-1847.186+0.311610X_5$
(-4.60)(13.52)$R^2=0.91$ F=182.72 n=21
$Y=-1684.902+0.009504X_6$
(-4.132101)(12.97)$R^2=0.90$ F=168.16 n=21
$Y=-208.36+801.5840X_7$
(-0.53)(10.26)$R^2=0.85$ F=105.24 n=21

If given the significance level a = 0.05, check the t-distribution table to get the degree of freedom for the critical value of n-k t0.05/2(20) = 2.086, through the t-test there are X1, X2, X5, X6, and secondly, the decidable coefficients as a criterion for determining the importance of the explanatory variables, explanatory variables are important in this order: X1, X2, X5, X6, X7, X3, X4, and then the R2 The largest equation is used as the initial equation, i.e., the first regression equation Y = -710.6966 + 0.114856X1 is used as the basis for the introduction of X1, X2 , X5, X6, X7, X3, X4 in this order.
The final model that passes the test of significance and improves the decidable coefficient of the model is:
$Y=-1244.254+0.1222X_1+5.0172X_2-351.1414X_7$
(228.71)(0.02)(1.95)(110.97)
T= (-5.44) (5.39) (2.57) (-3.16)
$R^2=0.9829$ F=324.92 T=(2000-2020) DW=1.09

Table 3 Model test and modified OLS regression estimation results

Variable	Coemcient	Std.Error	Std.Error	Prob
C	-1244.254	228.7088	-5.440344	0.0000
X1	0.122240	0.022674	5.391087	0.0000
X2	5.017208	1.953863	2.567839	0.0200
X7	-351.1414	110.9741	-3.164173	0.0057
R-squared	0.982859	Mean dependent var		2768.956
Adjusted R-squared	0.979834	S.D.dependent var		3080.994
S.E.of Regression	437.5256	Akaike info criterion		15.16979
Sum squared resid	3254287	Schwarz criterion		15.36875
Log likelihood	-155.2828	Hannan-auinn criter.		15.21297
F-statistic	324.9187	Durbin-Watson stat		1.085856
Prob(F statistic)	0.000000			

4.5 Tests and corrections for heteroskedasticity

4.5.1 .Test.

White's test for the corrected regression model yields the following results

Table 4 White test results

Heteroskedasticity Test: White			
Null hypothesis: Homoskedasticity			
F-statistic	3.926315	Prob. F(9,11)	0.0183
Obs*R-squared	16.01477	Prob.Chi-Square(9)	0.0666

From Table 4, it can be seen that TR2 =16.01477 with a p-value of 0.0666 at a significant level of α=0.05, which is

greater than 0.05 accepting the original hypothesis, indicating that there is no heteroskedasticity in this model.

4.6 Autocorrelation test and correction

4.6.1 .Test.

Table 5 LM test results

Breusch-Godfrev Serial Correlation LMTest:			
Null hypothesis:No serial correlation at up to 1 lag			
F-statistic	3.673590	Prob. F(1,15)	0.0733
Obs*R-squared	3.921267	Prob.Chi-Square(1)	0.0477

From Table 5, it can be seen that TR2 = 3.921267 with a p-value of 0.0477, which is less than 0.05 at a significant level of $\alpha = 0.05$, rejecting the original hypothesis and indicating that there is autocorrelation in this model.

4.6.2 Correction

In this paper, the generalized difference regression is used to eliminate the autocorrelation of the model with the existence of autocorrelation by Cochrane-Ockert iterative method, and the results are shown in Table 6.

Table 6 Corrected results of the Cochrane-Ockert iterative method

Variable	Coemcient	Std.Error	Std.Error	Prob
C	-603.4661	159.6718	-3.779416	0.0016
X1	0.121571	0.018380	6.614148	0.0000
X2	3.053306	1.720415	1.774750	0.0950
X7	-209.1137	108.0204	-1.935872	0.0708
R-squared	0.964431	Mean dependent var		1765.056
Adjusted R-squared	0.957762	S.D.dependent var		1852.589
S.E.of Regression	380.7406	Akaike info criterion		14.89897
Sum squared resid	2319415	Schwarz criterion		15.09812
Log likelihood	-144.9897	Hannan-auinn criter.		14.93785
F-statistic	144.6117	Durbin-Watson stat		1.213390
Prob(F statistic)	0.000000			

The model obtained by the Cochrane-Ockert iterative method from Table 6 is as follows: the model of Y with X1 X2 X7 is reduced by generalized difference:

$\beta_0=\beta_0^*/(1-\rho)$, C=-603.47/(1-0.455)=-1107.28

$Y=-1107.28+0.1216X_1+3.0533X_2-209.1137X_7$

(159.6718)(0.018380)(1.720415)(108.0204)

T=(-3.779416)(6.614148)(1.774750)(-1.935872)

R^2=0.9644 F=144.61 T=(2000-2020) DW=1.213390

4.7 Heteroscedasticity test

4.7.1 Heteroskedasticity test for the presence of autocorrelation correction to obtain the model again

Table 7 Results of the Cochrane-Ockert iterative method of correction followed by heteroskedasticity test

Heteroskedasticity Test: White			
Null hypothesis: Homoskedasticity			
F-statistic	3.387545	Prob.F(9,10)	0.0354
Obs*R-squared	15.06025	Prob.Chi-Square(1)	0.0893

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From Table 7, it can be seen that TR2 =15.06025 with a p-value of 0.0893 is greater than 0.05 at a significant level of α=0.05, so the original hypothesis is accepted, indicating that there is no heteroskedasticity in this model.

4.8 Autocorrelation test

The existence of autocorrelation correction to obtain the model and then autocorrelation test, using the LM statistic to test whether the generalized difference least squares results have been eliminated autocorrelation:

Table 8. Corrected LM test results

Breusch-Godfrev Serial Correlation LMTest:			
Null hypothesis:No serial correlation at up to 1 lag			
F-statistic	2.537416	Prob.F(1,15)	0.1320
Obs*R-squared	2.893717	Prob.Chi-Square(1)	0.0889

As can be seen from Table 8, the P-value of TR2 has been 0.0889 > 0.05, accepting the original hypothesis that there is no autocorrelation, so after generalized differencing, the model eliminates autocorrelation, where R2 = 0.96 and F = 144.61.

4.9 Smoothness test

4.9.1 Correlogram test

In this paper, we use Eviews software to make correlation plots for the above model to determine the smoothness of the time series:

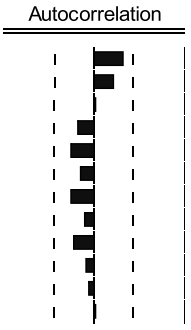

Figure 1 Using correlation plots to determine the results of the smoothness test

From the autocorrelation graph shows an oscillatory decay alternating positive and negative until zero, the graph is trailing, indicating that the time series is smooth.

4.9.2 Time path diagram test

In this paper, the use of Eviews software, the above model to make the time path diagram to determine the smoothness of the time series

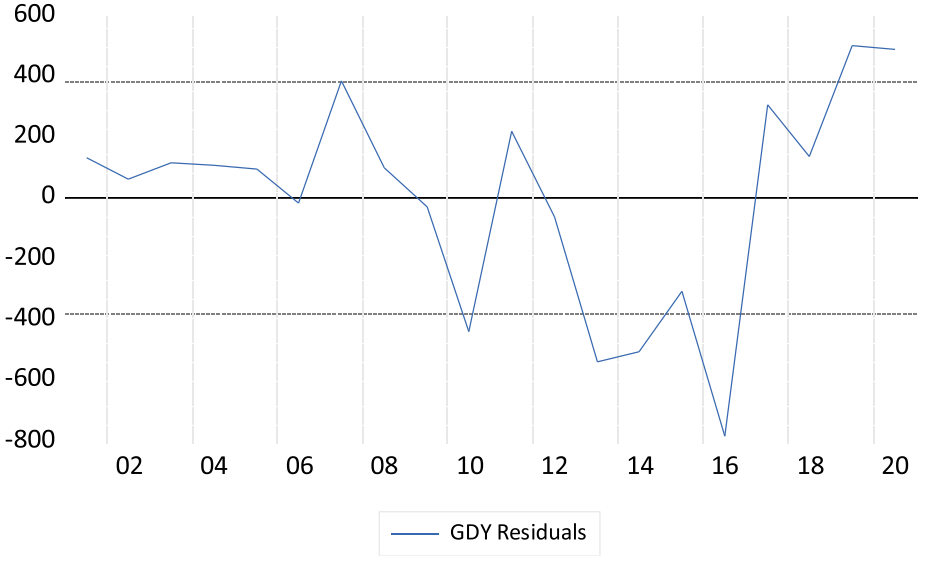

Figure 2 Using time path diagrams to determine the results of the smoothness test

From the image, it can be seen that the graph revolves around a process of constant fluctuation of the mean value rather than having different means (e.g., constant rise or constant fall) at different time periods, and it can be concluded that the time series is smooth.

5. Summary and Recommendations

5.1 Summary

The study shows that the development of tourism economy in Hunan Province is significantly affected by three factors: the number of tourists received (X1) increases by 10,000 person-times, which leads to an increase in revenue of RMB 121.6 million; the number of performing arts groups and museums (X2) increases by 1, which contributes to RMB 305.33 million; and the number of 5A scenic spots (X7) decreases by RMB 20,911.37 million per increase in number of 5A scenic spots (X1) and (X2) are positively driven, and X7 is positively driven, and X7 is positively driven, and X7 is positively driven. X1 and X2 are positively driven, while X7 is negatively impacted by over-reliance on ticket economy, diminishing marginal benefits and inefficient management, reflecting the structural contradiction between the expansion of the quantity and the improvement of the quality of tourism resources.

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