Excel and mathematical statistics-based students' physical health status evaluation model research

Lijuan Ma

Institute of Physical Education, Hunan University of Technology, Zhuzhou 412008, Hunan, (CHINA)

ABSTRACT

In order to establish student's body health status evaluation model, the paper firstly explains use 1000m (or 800m) race, Medicine ball throwing, standing long jump the three event can comprehensive test students' endurance, arm power, explosive power, lung capacity and body flexibility and coordination from physiological perspective, so use the three sports event to measure students' physical quality is proper. Then according to regional differences, randomly selects ten representative schools to analyze, use Excel to solve each school boy students and girl students each event test performance, use samples average value and samples variance to analyze, it gets each school each event test performance. In the following, select each school each test item boy students' test performance to establish single factor variance analysis model. Establish null hypothesis and alternative hypothesis; apply statistics to carry out variance test. Finally analyze and handle with given data, apply Excel fitting functions to predict boy students each item's physical ability test performance in future years, and gives out relative measures and suggestions that can strengthen students' physical ability.　© 2014 Trade Science Inc. - INDIA

INTRODUCTION

Teenager students' comprehensive development and enhance health issue have become hotspot of whole world concerns. In 2005, Chinese students' physical health and health investigation result showed that students' physical comprehensive quality was slightly in the diminishing trend, in order to guide students to correct recognize and understand their health status, completely turned things around, practical improved students' health level, Chinese education ministry, general administration of sport of China jointly published "Students' physical health criterion (trial plan)", and specific implemented in school, according to students' growth features and rules, grouped testing subjects according to grades, primary school grade one and two as one group, primary school grade three and four as one group, primary school grade five and six as one group, junior high school and senior high school every grade as one group, university as one group, comprehensive evaluated students' physical health status from body shape, body function, entity quality and other aspects, in testing contents, it selected some elements that were closest related to students' body development and body health quality as testing contents. By a series of plentiful and colorful contents, it propelled to students to take

FULL PAPER

positive exercises, so that really realized the purpose of improving students' physical health level.

Li Ping (2005) commented on physical health measurement endurance quality test indicator effectiveness. Wang Jian, Deng Shu-Xun[4] pointed out step test index could only make evaluation of subjects status as good or bad, which couldn't make accurate evaluation. Wu Ping (2007) made track research and analysis of students' physical health criterion test indicators. Zhao Qiu- Shuang[7] studied on students' physical health criterion test status and countermeasures. Wu Bing, Chen Jian-Feng, He Yue (2006) studied on "Students' physical health criterion" test results and students' exercise awareness correlations.

The paper applies Excel fitting functions to predict students' each item physical ability test result in future years, and provides relative measures and suggestions that can enhance students' physical ability.

MODEL ESTABLISHMENT AND SOLUTION

Three events measurement criterion rationality analysis

According to "Students' physical health criterion" requirements, students only need to fulfill following six testing items: height, weight, lung capacity, 1000m (or 800m), 50m running (or standing long jump), grip (or sit-up (female) or sit and reach).

By consulting information, we can define to select 1000m (or 800m), Medicine ball throwing, and standing long jump three events as students sports results that is reasonable and scientific.

(1) 1000m (800m)

1, it can improve cerebral cortex excitement, increase hypothalamus heat-regulating center working ability. 2, it can speed up blood circulating, adjust blood distribution, improve respiratory system functions. In addition, when running, it strengthens respiratory strength; enlarge respiratory depth, effective increase lung ventilator capacity, which has good effects on respiratory system. 3, It possesses strengthen nerve system functions, eliminates brain workers' fatigue, and prevent neurosism. 4, Promote to human body metabolism, control weight, and prevent obesity. Therefore, 1000m (800m) can well reflect body function.

(2) Medicine ball throwing

It is a kind of human race basic technology, is a skill that human use heavy things to self-defend and fight back when is attacked in extreme cases, throwing further shows strength is enough and lethality is large, and can kill target in far distance. Medicine ball throwing mainly reflects forearm and hand muscle strength, and also a good indicator to reflect muscle overall strength. Use medicine ball throwing to test students' arm force is safe and can achieve purpose.

(3) Standing long jump

It is measuring students' forward jumping instant leg leaping ability and lower limbs muscle explosive power. And explosive power is the basis of strength, no strength; explosive power is out of the question, and also even let alone so-called endurance. Therefore, strength is an important indicator to measure body quality.

Above three items comprehensive test students' endurance, explosive power, lung capacity, body leaping and coordination. So we think use the three events to measure student' physical quality is reasonable, following are my personal plan:

Students's sports test result total scores are 30 scores, totally set three sports events:
Item one: Medicine ball throwing 10scores
Item two: Standing long jump 10 scores
Item three: Women 800m and Men 1000m 10 scores. Every item test result corresponding scores in "scoring criterion" (appendix 1) corresponding scores are the event scores, three events' scores sum is the examinee sports test final result.

Different schools each item students' results significance difference analysis

According to regions differences, randomly select representative ten schools as samples to make difference analysis. Considering boy students and girl students' physiological and psychological differences, here do separate handling with selected each school boy students and girl students' measurement data results, and make comparison.

Use Excel to make mean analysis of selected ten schools' measurement statistical data, it gets following TABLE 1.

FULL PAPER

TABLE 1: Each school boy students and girl students' each item test average result

	Long distance running		Medicine ball throwing		Standing long jump	
	Men	Women	Men	Women	Men	Women
College A	8.80	9.05	8.38	7.31	7.75	7.90
College B	8.98	9.00	8.29	7.01	7.99	8.12
College C	7.44	8.05	7.21	5.43	6.41	7.07
College D	8.90	9.44	8.10	7.10	7.27	7.85
College E	8.90	9.42	8.13	6.99	7.73	8.39
College F	8.89	8.75	8.20	6.55	7.48	7.51
College G	8.14	8.22	7.75	5.11	6.92	6.79
College H	8.68	9.47	7.70	6.24	7.18	7.60
College I	9.08	9.52	8.55	7.45	8.16	8.52
College J	8.10	9.23	7.97	6.50	7.48	8.00

Long distance running test scores of man and women for each school
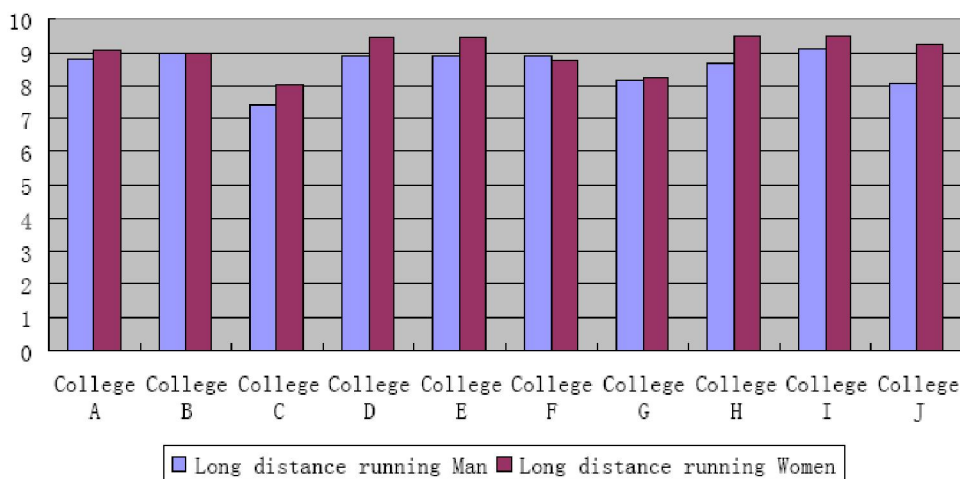

Figure 1 : Long distance running test scores of man and women for each school

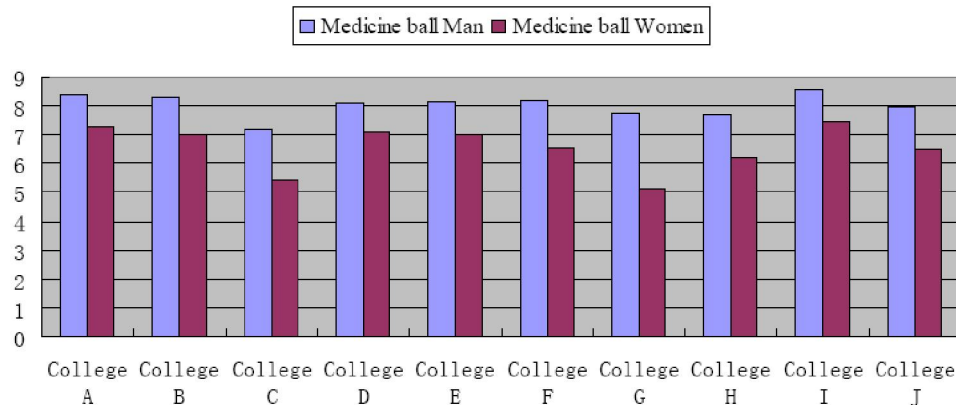Medicine ball test scores of man and women for each school

Figure 2 : Medicine ball throwing test scores of man and women for each school

By TABLE 1 and bar-shaped Figure1-3 analysis, it can get for same item test project, different schools' test results have no significant difference in mean value, and basic level keeps the same. In long distance run-

FULL PAPER

ning and standing long jump test, each school boy students' average result is lower than girl students', but differences are not remarkable. And in medicine ball test, body students' average results are obvious higher than girl students. Analyze form physiologic perspective, the result is also reasonable. Due to mean value differences are not remarkable, only use mean value to analyze cannot get good conclusion. Therefore, it needs to carry on variance analysis on the basis of mean value analysis.

In Excel, do variance handling with selected ten school's measurement statistical data, it gets following result TABLE 2.

By TABLE 2 and broken line Figure 4-6 analysis,

it can get for long distance running and standing long jump test, each school no matter boy students or girl students, result variance is not obvious that fluctuation is small. To medicine ball test, each school difference is remarkable; and same school boy students and girl students result variances differences are not obvious. Due to above analysis effects are not obvious, to get relative remarkable result, it needs to further analyze, so, it needs to adopt single factor analysis method.

Carry out single factor variance analysis of each school each test item results.

Firstly on the basis of single factor test results, solve total variance V, intra-class variance V_w , inter-class

TABLE 2 : Each school boy students and girl students each item test result variance

	Long distance running		Medicine ball throwing		Standing long jump	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
College A	1.66	1.34	0.88	3.98	2.35	1.78
College B	2.19	2.14	0.97	4.18	2.43	1.95
College C	4.51	3.18	1.11	2.92	3.00	2.44
College D	2.35	0.90	0.88	3.51	2.96	1.49
College E	1.96	1.18	0.94	4.22	2.50	1.69
College F	1.30	1.82	0.89	3.88	2.25	2.04
College G	2.67	2.13	0.86	2.52	2.82	2.47
College H	2.10	1.05	2.30	3.34	2.74	1.16
College I	1.56	0.88	0.73	3.55	2.29	1.52
College J	4.04	1.03	1.46	3.75	1.84	1.67

variance V_B .

Total variance: $V=\Sigma\left(x_{ij}-\overline{x}\right)^2$; intra-class variance: $V_w=\Sigma\left(x_{ij}-\overline{x_i}\right)^2$; inter-class variance: $V_B=\Sigma\left(\overline{x_i}-\overline{x}\right)^2$

From formula, it is clear that total variance measures all observed value x_{ij} to total average value $\overline{x}$ deviation degree, it reflects sampling random error size, intra-variance measures all observed value, x_{ij} to class average value $\overline{x}$ deviation degree, and inter-variance measures class average value $\overline{x_i}$ to total average value

TABLE 3 : Boy students' long distance running single factor variance analysis

SUMMARY				
Group	**Number of observation**	**Summation**	**Average**	**Variance**
Column 1	172	1514	8.802326	1.662451
Column 2	420	3687	8.778571	2.193096
Column 3	75	300.61	4.008133	0.544278
Column 4	153	1361	8.895425	2.350834
Column 5	316	2813.5	8.903481	1.956528
Column 6	109	969.5	8.894495	1.296636
Column 7	53	431.5	8.141509	2.66709
Column 8	65	564	8.676923	2.104928
Column 9	99	898.5	9.075758	1.56308
Column 10	30	243	8.1	4.041379

FULL PAPER

Long distance running test scores variance of man and women for each school
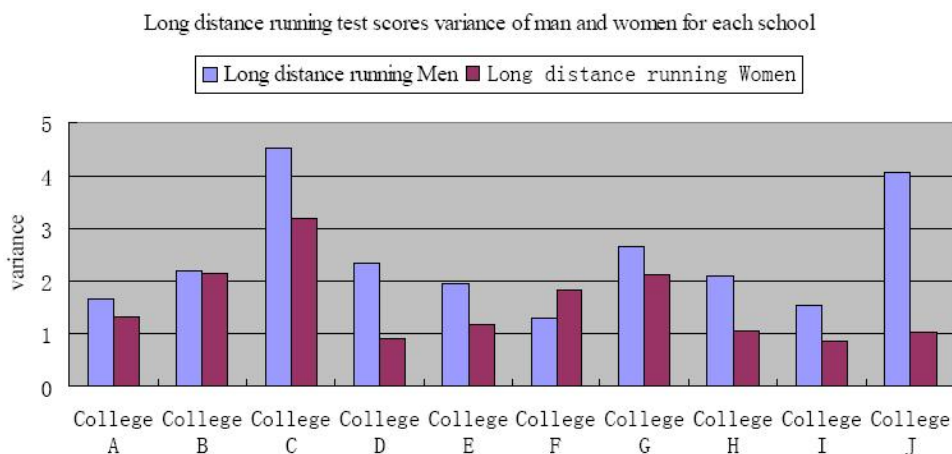
Long distance running Men ■ Long distance running Women

Figure 4 : Long distance running test scores variance of man and women for each school

Medicine ball test scores variance of man and women for each school

Medicine ball Men ■ Medicine ball Women

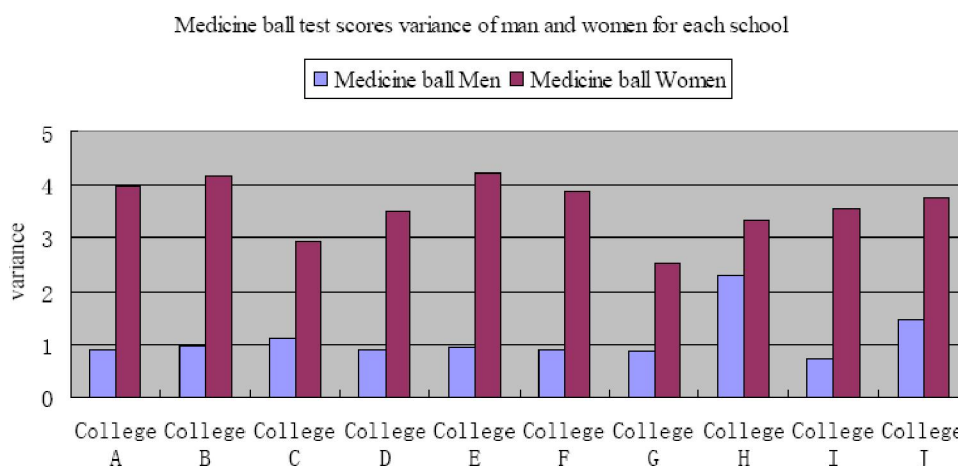**Figure 5 : Medicine ball throwing test scores variance of man and women for each school**

Standing long jump test scores variance of man and women for each school

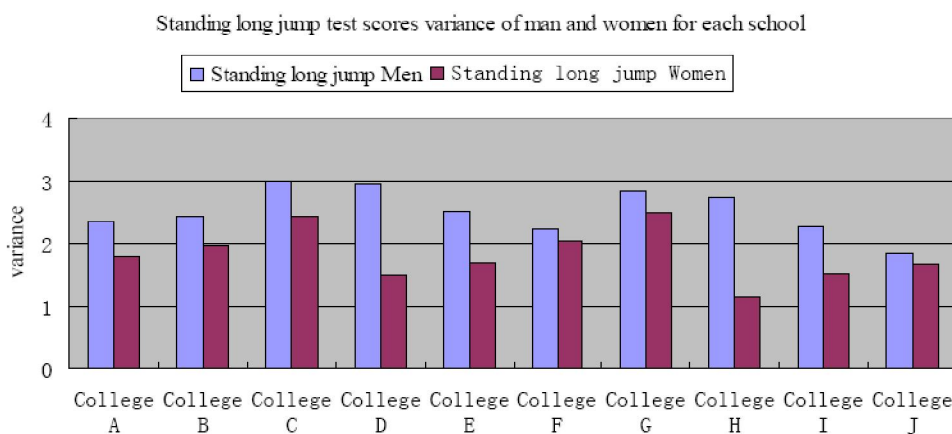Standing long jump Men ■ Standing long jump Women

Figure 6 : Standing long jump test scores variance of man and women for each school

TABLE 4 : Boy students' long distance running result difference test

Variance analysis						
Difference source	**Squares sum**	**Freedom degree**	**Mean square**	**F ratio**	**P-value**	**F crit**
Inter-class	1693.589	9	188.1765	96.13425	3.1E-141	1.886185
Intra-class	2900.918	1482	1.957435			
Total	4594.507	1491				

FULL PAPER

TABLE 5 : Boy students' medicine ball result single factor variance analysis

SUMMARY

Group	Number of observation	Summation	Average	Variance
Column 1	172	1441.5	8.380814	0.884834
Column 2	420	3447	8.207143	0.968923
Column 3	75	541	7.213333	1.109279
Column 4	153	1239	8.098039	0.878483
Column 5	316	2570	8.132911	0.936247
Column 6	109	893.5	8.197248	0.893603
Column 7	53	410.5	7.745283	0.861756
Column 8	65	500.5	7.7	2.303125
Column 9	99	846.5	8.550505	0.727015
Column 10	30	239	7.966667	1.464368

deviation degree, it reflects system error.

On this basis, it can also get inter-class average variance and intra-class average variance:

Inter-class average variance: $\hat{S}_B^2 = \dfrac{v_B}{a\text{-}1}$; intra-class

average variance: $\hat{S}_w^2 = \dfrac{v_w}{ab-a}$

On the condition that variances are equal, it should test n pieces of global average values are equal or not, and should firstly give null hypothesis and alternative hypothesis.

$H_0 : \mu_1 = \mu_2 = \cdots = \mu_n$ $H_1 : \mu_1, \mu_2 \ldots \mu_n$ not fully equal.

Then it can apply F statistics to carry out variance

test: $F = \dfrac{v_B / (a\text{-}1)}{v_w / (ab\text{-}b)} = \dfrac{\hat{S}_B^2}{\hat{S}_W^2}$

TABLE 6 : Boy students' medicine ball result difference test

Variance analysis

Difference source	Square sum	Df freedom degree	Mean square	F ratio	P-value	F crit
Inter-class	115.1597	9	12.79552	12.89775	5.7E-20	1.886185
Intra-class	1470.254	1482	0.992074			
Total	1585.413	1491				

TABLE 7 : Boy students' standing long jump result single factor variance analysis

Variance analysis: single factor variance analysis

SUMMARY

Group	Number of observation	Summation	Average	Variance
Column 1	172	1333.5	7.752907	2.349407
Column 2	420	3345.5	7.965476	2.433769
Column 3	75	480.5	6.406667	2.997928
Column 4	153	1112.5	7.271242	2.957194
Column 5	316	2441.5	7.726266	2.498641
Column 6	109	815.5	7.481651	2.25429
Column 7	53	367	6.924528	2.821118
Column 8	65	466.5	7.176923	2.73774
Column 9	99	808	8.161616	2.28994
Column 10	30	224.5	7.483333	1.83592

The statistics conforms to numerator freedom degree a-1, denominator freedom degree as ab-a' F distribution.

Given significance level a, if calculated F statistical value is less and equal to critical value

TABLE 8 : Boy students' standing long jump result difference test

Variance analysis

Difference source	Squares sum	Freedom degree	Mean square	F ratio	P-value	F crit
Inter-class	255.3904	9	28.37671	11.29598	3.08E-17	1.886185
Intra-class	3722.943	1482	2.512107			
Total	3978.333	1491				

$F_\alpha (a\text{-}1, ab\text{-}a)$ according to samples, then it shows null hypothesis H_0 is false, total average value is not fully equal, differences is not only caused by random factors.

Each school boy students' long distance running results analysis:

According to TABLE 3 and TABLE 4, if take α=0.05, due to p value is 3.1E-141, is less than α, we think individual levels have significant differences.

Each school boy students' medicine ball results analysis

FULL PAPER

According to TABLE 5 and TABLE 6, if takeα=0.05, due to p value is 5.7E-20, is less thanα, we think individual levels have significant differences.

Each school boy students' standing long jump results analysis
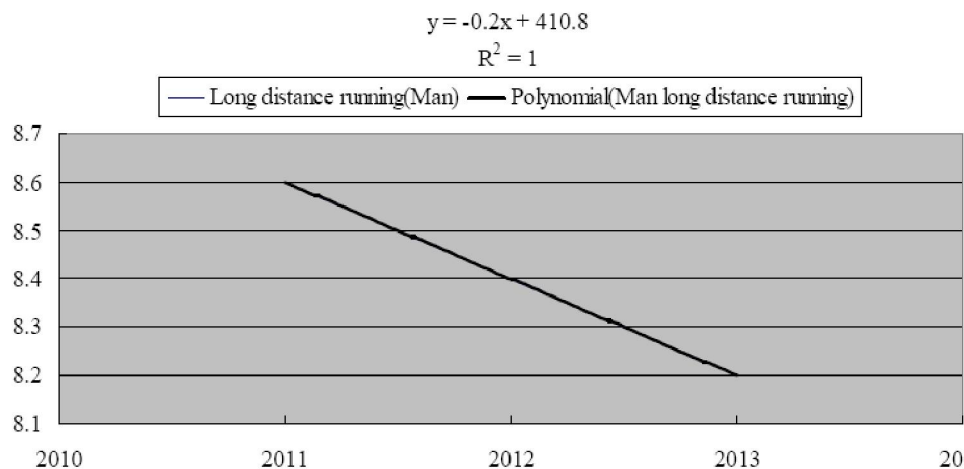
According to TABLE 7 and TABLE 8, if

$$y = -0.2x + 410.8$$
$$R^2 = 1$$

Figure 7 : Boy students' 1000m test fitting Figure

$$y = 0.1x^2 - 402.5x + 405023$$
$$R^2 = 1$$
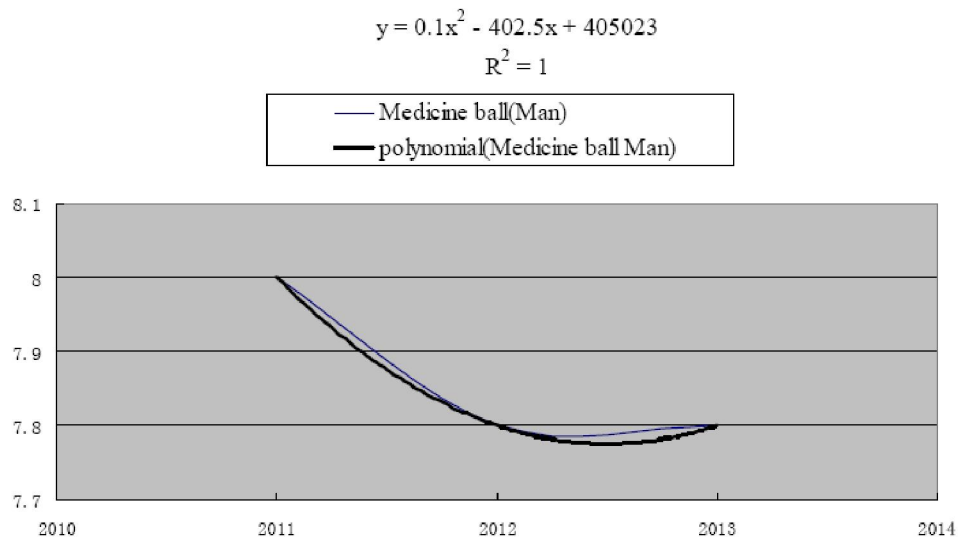
Figure 8 : Boy students' medicine ball test fitting figure

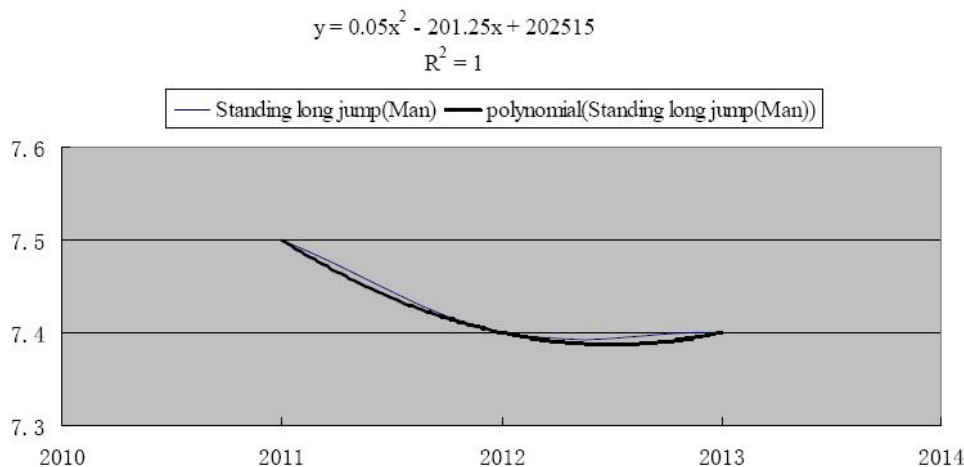$$y = 0.05x^2 - 201.25x + 202515$$
$$R^2 = 1$$

Figure 9 : Boy students' standing long jump fitting figure

FULL PAPER

TABLE 9 : Every year boy score average value

	1000m	Medicine ball	Standing long jump	Total score
Year 2009	8.6	8.0	7.5	23.6
Year 2010	8.4	7.8	7.4	23.8
Year 2011	8.2	7.8	7.4	23.3

take $\alpha=0.05$, due to p value is 3.08E-17, is less than α, we think individual levels have significant differences.

Based on above analysis, it can get each school each item test project result difference is significant.

Analysis data obtained other information

Analyze data, apply Excel to draw chart, it predicts boy students' physical ability test result in future years and fitting function, as following Figure 7-9:
(1) Boy students 1000m test
(2) Boy student's medicine ball test
(3) Boy students standing long jump test

CONCLUSION

By above boy students' each item test fitting, it can predict students' physical ability test levels in future years. In future years, boy students 1000m test results will tend towards stability, and in medicine ball and standing long jump the two items tests, average results fluctuation are great; By data, it can also make clear that every year there are many students' cancel testing due to diseases, and girl students' cancelling number is more than boy students. By their physical ability test levels, it indirectly reflects their nutrition is balanced or not and directly reflects their exercising status at ordinary times.

REFERENCES

[1] Yang Yunxia; Analysis On Difficulty Elements Composition Of Individual Man In The 12th World Aerobics Championship. Journal of Anhui Sports Science, **34(1)**, 35-37, 40 **(2013)**.

[2] Li Li, Mi Zhongqi, Bi Shiyong; An Analysis on Difficult Movement in the 11th World Sports Aerobics Championships. Journal of Hubei Sports Science, **32(6)**, 510-511, 487 **(2013)**.

[3] Hu Xiang, Zhou Jian-she, Tan Hui-fang, Shen Rui; Analysis of Difficulty of Movements in the 2002 National Aerobics Championship. Journal of Beijing Sport University, **27(2)**, 281-282 **(2004)**.

[4] Zhang Xiao-long, Wang Jing; Analysis about Main Factors of Impacts to Enhance China's Sport Aerobics Athletes Technique Level of Basic Pace. Journal of Guangzhou Physical Education Institute, **26(4)**, 67-69 **(2004)**.

[5] Liu Ying, Liu Jian-bing; On the Development Trend of Aerobic Gymnastics from the 9th Aerobic Gymnastics World Championship. Journal of Capital College of Physical Education, **19(3)**, 122-124 **(2007)**.

[6] Sang Guo-qiang; A Probe into the Disparities between Technical Levels of Competitive Aerobics of China and General Level of the World. Journal of Beijing Sport University, **27(10)**, 1427-1430 **(2004)**.

[7] Zhang Xiao-ying, Luo Huang; An Analysis on Difficult Movement in Men's Individual Event in the 9th World Sports Aerobics Championships. Journal of Beijing Sport University, **31(11)**, **(2008)**.

[8] Zhang Xiao-ying; An Analysis on Women's Single Difficulty Movements of World Top Gymnastics Aerobics Competitions. Journal of Beijing Sport University, **12**, **(2009)**.