Analysis of Students' Score

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Abstract. The exam achievement is normal distribution verified by MATLAB according to the inspection method of κ and the students' original scores, which is based on education statistics and meterage theory. Using quantitative analysis, it has been proved that the main cause of so many lower scores students is too difficult test questions by the inspection method of χ^2. It guides the teachers who set the questions to lower the difficulty in the similar tests.

Introduction

Nowadays, test is used to verify and evaluate the teaching quality in the teaching management of most colleges and universities. Usually, at the end of term the course teachers will set the examinations for their own courses and analyze the quality of the test paper. Teachers analyze the scores section, pass rate, excellence rate and the histogram of the original scores. However, it seldom evaluates the students' whole learning quality, learning and teachers' teaching methods by entity information obtained from distribution level. According to the entity information of the students' original scores, how to verify the test whether achieves the aims and requirements by the scientific method? In the case of the final exam scores in Advanced Mathematics of the 148 students who are in Grade 2009, Computer Science Department, Weinan Teachers University, using the strong statistical analysis tools of MATLAB, the students' theoretically scores have been calculated according to the education statistics and meterage theory and Pearson's main idea of inspection method of χ^2. Comparing the original scores with the theoretically scores, the quality of the test paper can be analyzed and discussed.

The Original Score Distribution and the Simple Analysis

The student's original exam scores are presented from low to high as follows:

46	48	49	53	55	55	56	57	58	58	58	59	60	60	60
60	61	62	63	63	63	65	65	65	65	65	65	66	66	66
67	68	68	69	69	70	70	70	70	70	70	71	71	71	71
72	72	72	72	72	73	73	73	73	73	73	73	74	74	74
75	75	76	76	77	77	77	78	78	78	78	78	78	78	78
78	78	78	78	78	78	78	79	79	79	79	79	79	80	80
80	80	80	80	80	81	81	81	81	82	82	82	83	83	83
83	83	84	84	84	84	84	84	85	85	85	85	85	86	86
86	86	86	86	87	88	88	88	88	88	89	89	89	90	90
91	91	91	92	93	93	94	94	95	95	95	97	98		

From the range from the above original scores, the range is obtained as $R=\max(X)-\min(X)=52$. the original scores are divided into grouping according to education statistics grouping formula[1,4] $h=1.87(n-1)^{2/3}$, calculate the class interval, $m=ceil(R/h)=4$. Assuming a class interval of m to determine the points in each group. the first point is $x_1=\min(x)-(h\times m-R)/2$, get $x_1=44$. Add the class interval m to the first point successive to

get the whole points, take the left closed and right open interval, write a simple program to count the frequency scores of each group, and draw the histogram and fitting curve, the results can be seen from Table I. and Fig. 1.

TABLE I. Each original frequency and theoretical frequency score

Groups	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Each points	44	48	52	56	60	64	68	72	76	80	84	88	92	96	100
original frequency	0	1	2	5	9	14	18	21	21	20	15	11	6	3	2
theoretical frequency	0	1	1	3	6	9	14	19	21	21	19	15	10	6	3

The following is a MATLAB program. The original score fitting curve and the histogram in the coordinate, the results can be seen from Fig. 1.

```
xi=ks:step:100;
yi=[s];
p=polyfit(xi,yi,7);
x1=ks:0.5:100;
y1=polyval(p,x1);
bar(ks:step:100,s)
hold on
plot(x1,y1,'-g')
grid on
title(' The original score fitting curve and frequency histogram ')
set(gca,'xtick',ks:step:100,'xticklabel',ks:step:100)
set(gca,'ytick',0:2:30,'yticklabel',mod(0:2:30,100))
legend('The Original score frequency ',' The original score fitting curve ',2)
xlabel('Score','fontsize',11)
ylabel('Frequency','fontsize',11)
```

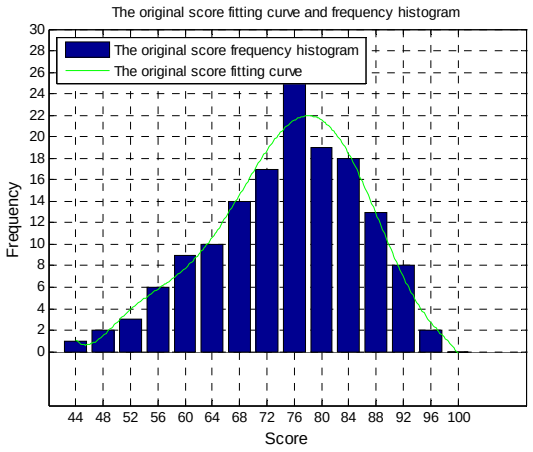

Fig. 1. The original score fitting curve and frequency histogram.

The Analysis Based on Inspection Method of κ

Is the distribution of original score reasonable or not? That is the original score distributions obey is normal distribution or not. We can test it based the inspection method of κ. If the differences between the Cumulative frequency distribution and the Specific theoretical distribution of the Sample data is insignificant, then infer the distribution of the sample taken from a particular family is a normal distribution[2].

If $H_0 : p(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$, because, $\mu = 76.2838$, $\sigma = 10.9321$, Use function normcdf(t_k), get the $F_0(t_k)$, then calculate $F_n(x)$, the results can be seen from Table II.

Table II. Table of Calculation process based on κ inspection

x_k	Frequency n_k	$t_k = \frac{x_k - \overline{x}}{\sigma}$	$F_0(t_k)$	$F_n(x)$	$\left\|F_0 - F_n\right\|$
46	1	-2.7702	0.0028	0.0000	0.0028
50	2	-2.4043	0.0081	0.0068	0.0013
54	5	-2.0384	0.0208	0.0203	0.0005
58	9	-1.6725	0.0472	0.0541	0.0069
62	14	-1.3066	0.0957	0.1149	0.0192
66	18	-0.9407	0.1734	0.2095	0.0361
70	21	-0.5748	0.2827	0.3311	0.0484
74	21	-0.2089	0.4173	0.4730	0.0557
78	20	0.1570	0.5624	0.6149	0.0525
82	15	0.5229	0.6995	0.7500	0.0505
86	11	0.8888	0.8129	0.8514	0.0385
90	6	1.2547	0.8952	0.9257	0.0305
94	3	1.6206	0.9474	0.9662	0.0188
98	2	1.9865	0.9765	0.9865	0.0100

It can be seen from Table II. that $D_n = \max\left|F_0 - F_n\right| = 0.0557$, $\alpha = 0.05$, $n = 148$ get the critical of κ inspection $D_{n\bullet\alpha}$ based on the Matlab function kstest, get $D_{n\bullet\alpha} = 0.1104$, according to $D_n = 0.0557 < D_{n\bullet\alpha} = 0.1104$, accept H_0, The experimental results suggest the original examination score is normal distribution.

The Comparative Analysis of Anastomosis Between the Original Score Distribution Curve and the Theory Scores Distribution Curve

Experience shows that the scores of examination should obey the normal distribution. Use the method of Pearson's goodness-of-fit χ^2 inspection[3,5]. The result can be seen from Table III. Number of groups is k, set each actual frequency n_k and each theory frequency np_k.

Table III. The result of Pearson's goodness of fit χ^2 inspection

Interval	n_k	np_k	$(n_k - np$	$\frac{(n_k - np_k)^2}{np_k}$
Under 60	8	5	9	1.80
60-64	9	6	9	1.50
64-68	14	9	25	2.78
68-72	18	14	16	1.14
72-76	21	19	4	0.21
76-80	21	21	0	0.00
80-84	20	21	1	0.05
84-88	15	19	16	0.84
88-92	11	15	16	1.07
92-96	6	10	16	1.60
Above 96	5	9	16	1.78
Σ	148	148		12.77

We can get the $\chi_{\alpha}^{2}=15.5$ by calculating the unilateral critical of χ^{2} inspection when the degree of freedom is 11-2-1=8, and $\chi^{2}=12.77<\chi_{\alpha}^{2}=15.5$. So accept the original hypothesis. The original score fitting curve and theoretical scores fitting curve in the coordinate is to judge the reasonable degree between the original score and theoretical score, the result can be seen from Fig.2.

```
mu=mean(X);
sigma=std(X);
k=1;yi=[];
for x=ks:step:100

   yi(k)=round(size(B,2)*(normcdf(x,mu,sigma)-normcdf(x-step,mu,sigma))+0.
   05);
  k=k+1;
end
p=polyfit(xi,yi,7);
x2=ks:0.5:100;
y2=polyval(p,x2);
grid on
plot(x1,y1,'-b',x2,y2,'.r')
title(' The original score fitting curve and theoretical score fitting curve')
legend(' The original score fitting curve ','The theoretical score fitting curve
   ',2)
xlabel('Score','fontsize',11)
ylabel('Frequency','fontsize',11)
set(gca,'xtick',ks:step:100,'xticklabel',ks:step:100)
set(gca,'ytick',0:2:30,'yticklabel',mod(0:2:30,100))
```

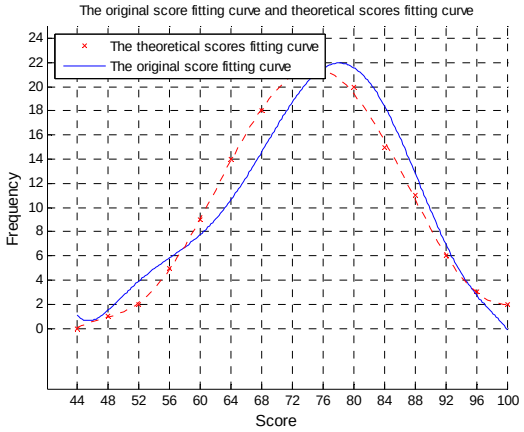

Fig.2. The original score fitting curve and theoretical scores fitting curve

It can be seen from the Fig.2 that two curves don't anastomosis well. The number of students' score are more between 46-68 points than that between 84-100 points. Have too much failing students. Maybe the test paper is too difficult or the marking standard is more stricter, but which is the main reason?

Choose the scores of 37 students as the sample, use the method of quote volume computer to input each examination question of each student, calculating the difficulty of each examination question and the overall test paper. It can be seen from the Table Ⅳ that the difficulty of number 3, 6, 7 are greater than other examination questions. Especially the difficulty of the seventh problem harder than 0.7, the difficulty of the overall test paper 0.5237 is slightly large. So there was too much failing students, it is consistent with the actual results.

Table Ⅳ. Average score and difficulty value of each topic

Number	one	two	three	four	five	six	seven
Average score	15.0294	11.3529	4.0588	8.4412	6.1176	7.7353	5.5588
Difficulty value	0.3738	0.3431	0.6018	0.2559	0.4439	0.6265	0.7134

Conclusion

In conclusion, by the inspection method of κ and the students' original scores, that the exam achievement is normal distribution has been verified in this thesis. Meanwhile using the inspection method of χ^2, it has been quantitatively analyzed. The result is that as a common final test, there are too many lower scores students and very few higher scores ones. Sampling one class to analyze the difficulty of the test questions, it proves that the main cause of so many lower scores students is too difficult test questions. It guides the teachers who set the questions to lower the difficulty in the similar tests.

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