An introduction of statistical testing in secondary education

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1. Contents of Text in Japanese senior high school

In senior high school in Japan, the students learn Mathematics 1, 2, 3 and Mathematics A, B, C. Generally, in the first grade they study Mathematics 1 and A, and Mathematics 2 and B in the second grade. The students who major in Science, Engineering, Medicine and so on in the university study Mathematics 3 and C in the last grade.

Mathematics 1 include the following contents of Probability and Statistics;

- point sets, permutation ${}_nP_r$, combination ${}_nC_r$,
- classical definition of probability, basic laws of probability, independent trials, calculation of probability, expectation of discrete variable.

Mathematics A and 2 do not include Probability and Statistics. Mathematics B include the following contents;

- basic properties of probability, conditional probability, multiplicative law of probability, independence of events,
- probability distribution of discrete variable, expected values of random variables,
- binomial distribution, mean and standard deviation, law of large numbers.

Following to binomial distribution we may teach the testing of hypothesis. Generally, the teachers of Mathematics do not like to teach the mathematical properties without proof. In university we derive the criterion for the testing of hypothesis by Neymann-Peason theorem, likelihood ratio method and so on. It is not possible in high school to teach those. So it is the problem how to teach it without difficult theorem. In the following we show an idea for it.

2. An Introduction of Statistical testing

On a dice A, the students say that even comes out more than odds. So, by the trials throwing the dice A we may expect to reject the null hypothesis

$$H_0 \ : \ p = q = 0.5$$

where p is the probability which odds occur, and q even. When the hypothesis H_0 was rejected, we accept the alternative hypothesis $H_1 \ : \ p < q$

Suppose that we throw the dice A, for example, 30 times.

Figure 1. Probability under the null hypothesis H_0 : p=q=0.5
Critical region is less than or equal 10, Significance level is 4.94%

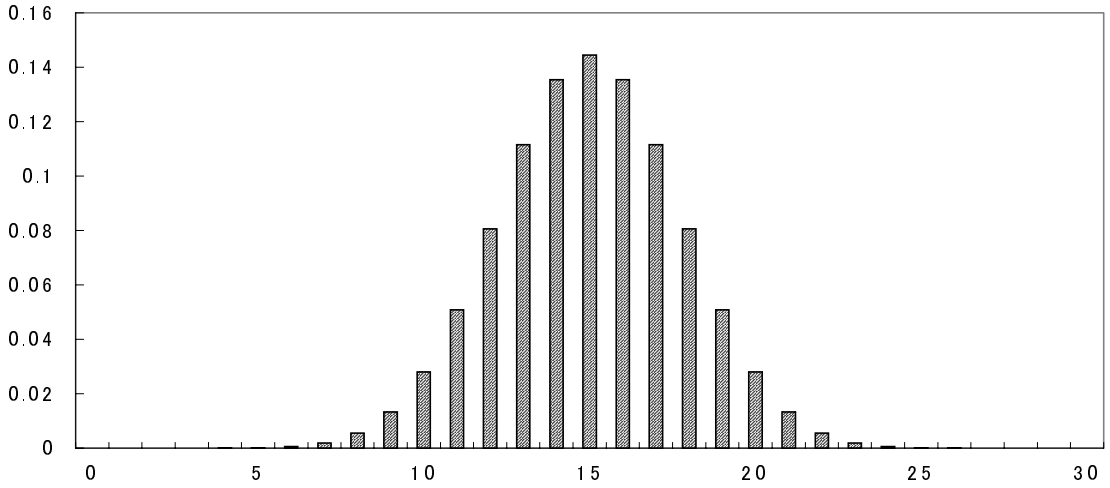
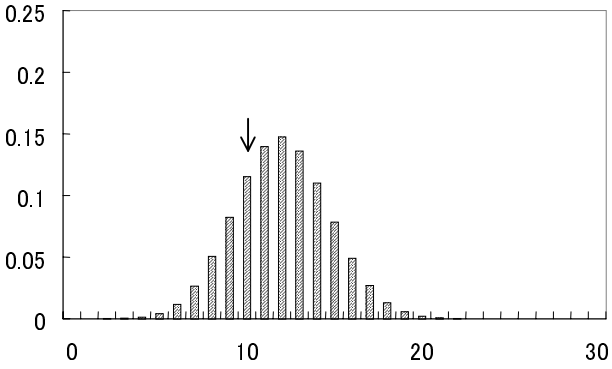


Figure 2. Probability under the alternative hypothesis

H_1 : p=0.4, q=0.6 and *power is 0.291*



H_1 : p=0.3, q=0.7 and *power is 0.730*

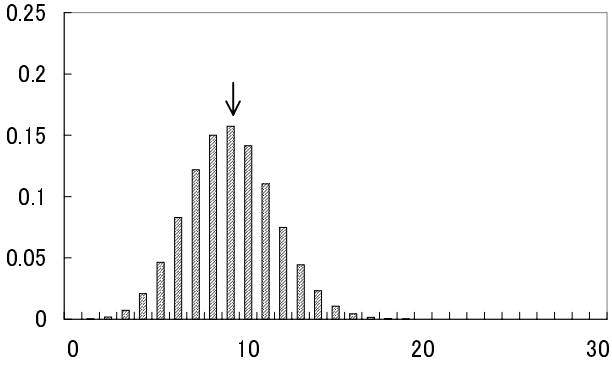
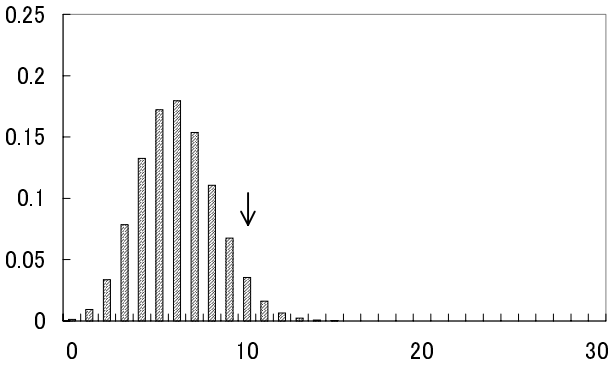
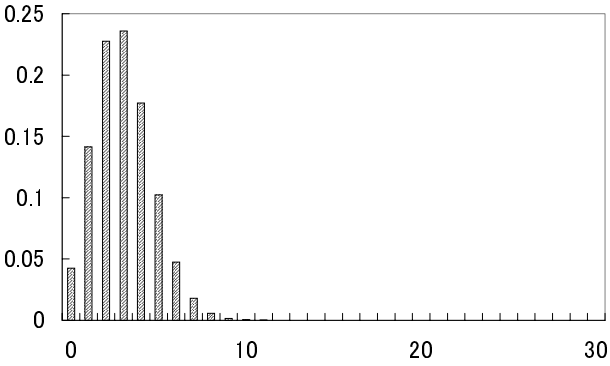


Figure 3. Probability under the alternative hypothesis

H_1 : p=0.2, q=0.8 and power is 0.974



H_1 : p=0.1, q=0.9 and power is 1.000



Reference

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