

*Aims and structure of Japan Statistical
Society Certificate*

Akimichi Takemura
University of Tokyo

November 3, 2012

KSS meeting

Certification of statistical skills : JSSC Examination

Japan Statistical Society started a series of examinations for students and professional statisticians last year.

JSSC Examination, stands for Japan Statistical Society Certificate Examination. It consists of the following 7 parts.

- Levels 1, 2, 3, 4 for students at various stages,
- Exam for professional survey statisticians,
- Exam for field survey interviewers,
- Joint exam with Royal Statistical Society (RSS/JSS exam)

(L1, RSS: written exam, others: mark sheet exam)

Summary — Background

- Quality Assurance Framework of Higher Education in Japan (MEXT)
- “Subject Benchmark Statements” Framework (SCJ)
- Revision of “Official Curriculum Guidelines” (MEXT)
- *Special Committee of Statistical Education* (JSS)
- Standard Reference for Statistical Education (JFSSA)

(these names explanationed below)

Summary — Structure of JSS Certificate

- Structure of JSSC Examination
 - 4 levels of statistics for students
 - Exam for field survey interviews
 - Exam for professional survey statisticians
 - Joint examination with Royal Statistical Society :
RSS/JSS Higher Certificate in Statistics
- Results from the first exam (20 November 2011) and latest figure for the second exam (18 Nov 2012)
- Example Question
- Organization : JSS established an incorporated foundation called *Japanese Association for Promoting Quality Assurance in Statistics*. Reason: financial independence from JSS.

List of names of organizations

- **MEXT: ministry of education.**
 - They control curriculum for elementary, junior high and senior high schools.
 - Curriculum for universities is not controlled by MEXT. “Academic freedom in universities”.
- **SCJ: Science Council of Japan. This represents academics. SCJ has partial influence on curriculum in universities.**
- **JFSSA : Federation of 6 statistical societies in Japan.**

Proposals by MEXT for university curriculum

- Ministry of Education (official name: Ministry of Education, Culture, Sports, Science & Technology, MEXT) proposed in 2008 to introduce “Quality Assurance Framework of Higher Education in Japan.”
- MEXT also asked *Science Council of Japan (SCJ)* to cooperate with MEXT in making up this framework.
- SCJ then asked its members elected from academic societies to make up and examine the draft of *Subject Benchmark Statements Framework*.

Subject Benchmark Statements by SCJ

- When SCJ asked its members representing academic societies to make up the draft of *Subject Benchmark Statements Framework*, the general idea was accepted.
- Unfortunately, no university in Japan has Department of Statistics. Thus, in SCJ, statisticians belong to several divisions such as Mathematics, Economics, Sociology, Biology, *etc.*
- Researchers working in various fields of statistics proposed to SCJ that they will themselves edit the *Subject Benchmark Statements for Statistics*.

Committee of Statistical Education in JSS and JFSSA

- **Japan Statistical Society (JSS) has Special Committee of Statistical Education, whose members consist of more than forty statisticians and educators.**
- **Another organization who played an important role is Japanese Federation of Statistical Science Associations (JFSSA). It consists of six academic societies related to statistical methods. JSS is a member of JFSSA.**

Standard Reference for Statistical Education

- Responding to the request by SCJ, JFSSA appointed its members to complete the editing of *Subject Benchmark Statements for Statistics*.
- The document was submitted to SCJ in 2010. JSS also published a pamphlet and a summary brochure on the document.
- JSS regards the Benchmark Statements as the “Standard Reference” for college level statistical education.

Revision of Official Curriculum Guidelines by MEXT

- Around the same time, MEXT expressed that Japanese high school students should be equipped with quantitative skills, after they observed poor performance of Japanese students in some international comparison.
- An example was the result of PISA (Programme for International Student Assessment) conducted by OECD. MEXT seemed to have judged that relative performance of Japanese young students has been declining.
- MEXT revised *Official Curriculum Guidelines* and emphasized the importance of statistical thinking and data analysis.

Quality Assurance of statistical literacy : JSSC

- JSS regards contribution to quality assurance in higher education as one of its important missions.
- JSS Certificate Exam was first conceived as a tool to assure the quality of statistical education at college level.
- Following the revision of Curriculum Guidelines, which become effective this year, JSS has decided to support enhancing statistical skills of high school students.

Quality Assurance of statistical literacy : JSSC

- Yet another request came from official statisticians and research companies. A certification system is useful for interviewers working mainly in official statistics.
- Also, research companies can prove their quality to government and other customers if their employees have certifications given by JSSC.
- Japanese government now relies on private survey companies to conduct official statistical surveys. But inexpensive proposals are usually less reliable. Thus, we need a system for judging the quality of companies.

Structure of JSSC Examination

- The Japan Statistical Society started JSSC and completed its first examination on 20 November 2011.
- **The JSSC Examination Center** of Japanese Association for Promoting Quality Assurance in Statistics managed the whole examination.
- The examination and certification was a result of long and hard discussions among officials of JSS, because of the financial risk involved in starting the examination system.

Structure of JSSC Examination : Level 1

- **Level 1** is recommended to college students majoring in subjects where statistical methods are widely used.
- It is the highest level exam for undergraduate students and consists of two parts.
 - First part deals with **Statistical Theory**, and it is compulsory to all applicants.
 - Second part deals with **Application of Statistics**. It consists of 12 problems covering different areas of application and applicants are requested to answer to 3 questions.
 - Level 1 Exam is **2 hours (120 minutes)** long.

Structure of JSSC Examination : Level 1

- Areas of application
 - Psychology
 - Education
 - Economics
 - Sociology
 - Business
 - Mathematical Sciences
 - Industrial Sciences
 - Medicine
 - Biology

- Typical college students majoring in sciences may pass Level 1 Exam only after studying a few (three or four) statistics courses and acquiring experience of data analysis in their major fields.

Structure of JSSC Examination : Level 2

- Typical college students majoring in sciences may pass Level 2 Exam, after they took an intermediate statistics course.
- For those students majoring in humanities or in social sciences, Level 2 Exam requires reasonable amount of effort.
- Level 2 is designed to meet the needs of all college level students who are interested in data analysis in their major field of study.
- Level 2 Exam is 1 hour and 30 minutes (90 minutes) long.

Topics covered by Level 2 Examination

- Collection and Compilation of Data
- Analysis and Presentation of Data
 - Descriptive techniques
 - Introductory probability theory
 - Random variables, expectation, distribution of some statistics
 - Scatter plot, correlation, simple regression
 - Statistical inference : interval estimation
 - Statistical inference : testing hypotheses
 - Statistical inference : regression analysis, analysis of variance

Structure of JSSC Examination : Level 3 and Level 4

- These level exams correspond to materials described in “Official Curriculum Guidelines” (MEXT) for junior high and senior high schools.
- **Level 3 Exam** covers the field called **Data Analysis**.
 - Basic concepts of statistics (Statistical Literacy)
 - Interpretation and relationship (Statistical Inference)
 - Utilization of statistical observations (Statistical Thinking)
- **Level 4 Exam** deals with **Use of Statistical Data**.
 - Basic descriptive statistics
 - Elementary probability
 - Making use of statistical data

Structure of JSSC Examination : Interviewers

- This Examination is designed to promote better understanding of data collection process, especially from the view point of official statistics.
- Topics of questions:
 - Role of Statistics
 - System of official statistics
 - Statistics Act
 - Data collection process
 - Use of statistical output
- This exam reflects troublesome situation of Japanese official statistical system and data collection.

The detail is omitted here since our experience may not be too useful for other countries.

Structure of JSSC Examination : Professional Statisticians

- The purpose of this examination is to certify practical knowledge of statistics which is useful for designing and conducting statistical surveys.
- When the government plans to choose a survey company to collect statistical data, open bidding system is employed. To show competitiveness of a company, this Certificate will play an important role.
- JSS expects that Japanese government will utilize this exam in a near future to enhance the quality of interviewers.

Structure of JSSC Examination : RSS/JSS Joint Exam

- RSS has been giving the examination for more than 20 years. They also have a contract with Hong Kong Statistical Society. We invited some people from Hong Kong to learn the arrangement.
- Based on a contract between RSS and JSS, JSS administered RSS/JSS Higher Certificate in Statistics in May of this year, at the same time as RSS. We had about 50 applicants (total number of modules over 200).
- The applicants can take this exam either in English or in Japanese. The papers are marked using the same standard that RSS has been applying.
- Some borderline examination books are actually sent to RSS for double checking the standards.

Structure of JSSC Examination : RSS/JSS Joint Exam

- It gives a thorough introduction to statistical theory and inference at intermediate level, stressing the importance of practical applications.
- It consists of 8 modules, each with an examination paper of one and a half hours (90 min.) containing four questions. The whole examination takes two full days.
- Candidates may enter for modules individually or in any combination. Candidates who pass in 6 modules (subject to some restrictions as to choice) are awarded the Higher Certificate in Statistics.

Structure of JSSC Examination : RSS/JSS Joint Exam

- RSS and JSS regard the level of this exam as intermediate in the system of professional examinations. In RSS, they have Graduate Diploma beyond Higher Certificate.
- In two years, JSS plan to extend the contract between RSS to include Graduate Diploma in JSSC Exam system. Graduate Diploma examination takes three days.

Prize for Statistical Activity : Statistical Graph Contest

- JSS also supports **Statistical Graph Contest**, that has been supported by the government to enhance statistical understanding of the people, putting emphasis on young students (elementary school and junior high).
- In 2011, JSS started to award prizes for good graphs.
- JSS also offers a special prize, **JSS President's Award** for the best statistical graph.

Result of 2001 JSSC Examination

Number of Candidates

Level	Applicants	Examinee	Passed
Level 2	396	346	143
Level 3	226	197	125
Level 4	27	23	16
Interviewers	296	280	161
Pro Statisticians	265	252	200
Sum	1210	1098	645
Level 4 (Activity)	25418	1139 Awards	

- The examination took place on 20 November 2011 in Tokyo, Osaka and Fukuoka.

The 2nd JSSC Examination this year

- In **18 November 2012**, 2nd JSSC Examination will take place in Sapporo, Sendai, Tokyo, Nagoya, Osaka, and Fukuoka.
 - Level 1 Exam will be given together with all exams given in 2011.
- The application period has ended and we now have more than 2500 applicants. The number of applicants have doubled from the first exam last year.
- With 2500 applicants, JSSC is now financially self-sustaining.

An example problem from the 2nd level exam (rough translation)

Q21. A university teacher asked 60 students of his class to measure their heart pulses for one minute. After one week the teacher again asked the same 60 students to measure the heart pulses. Assume that the data follow normal distribution. Based on the sorted data of the first week, the teacher divided his class into two groups of 30 students each: high pulse rate group and low pulse rate group. Let \bar{x}_H denote the average heart pulses for the high group and let \bar{x}_L denote the average for the low group.

An example problem from the 2nd level exam (rough translation)

Let \bar{y}_H and \bar{y}_L denote the averages of the heart pulses of the second week of the high group and the low group. The result of these measurement was as follows:

$$\bar{y}_H > \bar{y}_L, \quad \bar{y}_H < \bar{x}_H$$

Among the following five statements on this result, choose the most appropriate one.

An example problem from the 2nd level exam (rough translation)

1. The measurement of the second week was flawed.
2. The result $\bar{y}_H < \bar{x}_H$ is only by change. There is equal chance of observing $\bar{y}_H > \bar{x}_H$.
3. It is expected that $\bar{y}_L < \bar{x}_L$.
4. It is expected that $\bar{y}_L > \bar{x}_L$.
5. $\bar{y}_H < \bar{x}_H$ means that the students of the high group tried to lower their heart pulses between two weeks.

Future plans for further success

- Increase the number of applicants for level 3 and level 4 by allowing the group exams in junior high schools and senior high schools
- Concerning RSS/JSS exam, start the Graduate Diploma by 2014. We probably do not translate the problems and use English problems, but will allow the students to answer in Japanese. (cf. In Hong Kong, almost everybody answers in English.)
- Try to obtain official endorsement of JSSC from MEXT and other ministries.
- Ask companies to consider JSSC certificates in recruitment.

References and URL

Official Web site of JSSC Examination (in Japanese only)

<http://www.toukei-kentei.jp/>

JFSSA, Standard Reference for Statistical Education

<http://www.jfssa.jp/ReferenceStandard.pdf>

**Ministry of Education, Culture, Sports, Science & Technology
(MEXT)**

<http://www.mext.go.jp/english/>

Science Council of Japan (SCJ)

<http://www.scj.go.jp/en/index.html>