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BANGLADESH AGRICULTURAL RESEARCH PROJECT PHASE-II

Reports on Two Short Courses on THE APPLICATIONS OF STATISTICS IN AGRICULTURAL RESEARCH

October 1984

S C Pearce
G V Dyke
R E Kempson

Bangladesh Agricultural Research Council
International Agricultural Development Service

The Applications of Statistics in Agricultural Research

Reports on two short courses, Jan-Feb. and September 1984,

by

S.C. Pearce
G.V. Dyke
R.E. Kempson

of the Applied Statistics Research Unit of the University of Kent, U.K.

October 1984

The Applications of Statistics in Agricultural Research

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TERMS OF REFERENCE

for

DR. S.C. PEARCE, DR. R.E. KEMPSON and MR. G.V. DYKE of the Applied Statistics Research Unit, University of Kent, UK.

1. To prepare two short courses on the applications of statistics in agricultural experimentation.

2. To present the above short courses from 22nd January to 8th February and 10th to 30th September 1984

3. To make final reports on the above courses.

4. To make suggestions on the future needs for statistical training for agricultural research personnel in Bangladesh.

First Short Course on the Applications of Statistics in Agricultural Research

A Report by
S.C. Pearce, G.V. Dyke and R.E. Kempson

Duration

The course opened on Sunday 22nd January, 1984 and instruction continued until Wednesday 8th February. There were no classes on Friday and Saturday 27th, 28th January on Friday 3rd February, or on Tuesday 8th February, the last date coinciding with the opening of the Soil Science Conference in Dhaka.

The general pattern was as follows:

9:00 am	-	11:00 am	Classes
11:00 am	-	11:30 am	Tea break
11:30 am	-	12:30 pm	Classes
12:30 pm	-	2:00 pm	Lunch break
2:00 pm	-	3:45 pm	Classes
3:45 pm	-	4:00 pm	Tea break
4:00 pm	-	5:00 pm	Classes

On some days there were slight variations in this pattern. On each day of lectures the participants were given home tasks. Each evening, except the last, when there had been classes one of the team attended at the hostel for consultation from 8:30 pm to 9:30 pm. On Saturday 28th January someone was available from 10:00 am to 12:00 noon, 2:30 pm to 4:30 pm and 8:30 pm to 9:30 pm.

On Thursday 26th January and Thursday 2nd February the session from 4:00 pm to 5:00 pm was taken up by an examination to assess progress. As to homework, some seven assignments were marked in detail and the others were inspected.

On Tuesday 24th January, Thursday 2nd February and Monday 6th February the session from 2:00 pm to 3:45 pm took the form of practical work in the field.

Participants

There were 17 participants from BARI, 6 from BJRI, 3 from BRRI and one from CRWRC. Additionally there should have been a seventh participant from BJRI. Four observers joined the course, only one of whom, Mr. K.N. Haque of BARI, attended regularly.

For some sessions the biometricians were taught as a separate group, but mostly the class was not divided. In the third week participants were offered the choice of learning about either series of experiments or probit analysis, but not both. About eight opted for the latter subject, mostly biometricians.

The team was pleased that all the participants applied themselves seriously to their studies. All made good progress, though naturally some achieved more than others. The work of instruction was greatly forwarded by the friendliness and cooperation of the participants.

The previous statistical training of the agronomists was of fairly low standard. Some could calculate an analysis of variance but with little understanding of its purpose. The training of the biometricians had paid little attention to practical matters. Their mathematical knowledge was sound, but they were weak in matrix algebra, though that branch of

mathematics is essential to an understanding of modern statistical theory. Also neither group appeared to have much appreciation of the problems of the other.

Accommodation

The team was lodged in the BRRI hostel and members were well satisfied with the arrangements.

For the first week, the course took place in BARI Citrus and Vegetable Research Centre. Although accommodation was cramped, arrangements were satisfactory. For the last two weeks, the course moved to the main building of BARI. The lecture rooms were better but difficulties sometimes arose from other bodies that needed the same rooms.

Content of the course

The aim of the course was to combine theory and practice. The team believed that practice should be soundly based and theory should be well applied. To that end the agronomists were told what a helpful biometrician could do for them, while the biometricians were instructed with the agronomists on the practical aspect of field experiments.

In the first week experiments were approached from the point of view of error, how it arises, how it can be measured and how it can be controlled, those being matters of concern both to agronomists and biometricians. Thus, the analysis of variance was first derived by the method of sweeping and the usual standard designs were considered in that way. The use of blocks or rows and columns was examined as a practical measure to deal with certain difficulties and not as desirable in themselves. For everyone there was instruction in the practicalities of recording plots, preparing plans and laying out experiments in the field, with emphasis on possible small but important errors. The biometricians

were made aware of methods for dealing with complicated bodies of data, such as arise when mistakes are made. The agronomists were carefully instructed in elementary statistical methods to make sure they had a basis for what was to follow. Towards the end of the week everyone was introduced to the idea of contrasts.

In the second week the idea of contrasts was extended to cover orthogonal polynomials and factorial designs with special reference to 2^N designs. Emphasis was given to the interpretation and writing of reports. It was found that many could work out an analysis of variance without being able to explain what the conclusions meant. On that account the course was modified to give more practice in that important aspect, and later reports were much better. The biometricians were introduced to balanced incomplete blocks and lattices. For field work the whole class independently graded the plots of a maize experiment with results that were disappointing. A start was made on correlation and regression as preliminary to studying the analysis of covariance.

In the third week the analysis of covariance was studied in some detail but at different levels by agronomists and biometricians. Attention then turned to incomplete and defective data, again dealt with in parallel at mathematical levels. That led to the validation of data, thus returning to the original topic of the sources of error.

The special problems of intercropping experiments were also studied. Other special topics were probit analysis and the analysis of data from a series of experiments, both in space and time, the class being divided for that purpose. (It had been intended to have three options, but so many asked for intercropping and at least one other, that intercropping was made part of the main course.) A further practical exercise in scoring showed a great improvement, a satisfactory competence having been obtained. The afternoon of Wednesday 8th February was given over to a question and answer session, presided over by Dr. B.A. Greene.

A closing session was arranged for Thursday 9th February in Dhaka, at the Bangladesh Agricultural Research Council (BARC).

The evening sessions and those on Saturday 28th January were generally well attended and provided an opportunity for participants to clarify matters that had proved difficult. The team thought these sessions well worth while.

Further training

Participants needed more training than could be given in the time available. Some were especially promising and their names will be passed to Dr. E. Ahsan at BARC.

The biometricians especially need to learn more in a practical context. It would be a mistake to send any of them to take a Ph D in Mathematical Statistics at a university in the UK or US. That is not what they need and they might well leave the service of BARC if they were so qualified. Possible centres are the Indian Agricultural Research Statistics Institute at New Delhi and the International Rice Research Institute in the Philippines, though there are places in the US and UK, e.g. Reading University and Wye College in England, that should be considered. Before embarking on further study, however, they should learn more matrix algebra, but they could do that in Bangladesh

The development of biometricians with practical skills would help in the instruction of agronomists. Until there are statisticians in Bangladesh able to teach agronomists in a practical context, there will be a continuing need for courses such as the one just concluded.

The team is convinced that there will be little improvement in statistical knowledge so long as staff have access to so few books.

The team brought three copies each of

Cochran W.G. and Cox G.M. : Experimental Designs

Cox D.R. : The Planning of Experiments.

and one copy of

Little T.M. and Hills F.J. Agricultural Experimentation.

Each participant received a copy of

Clarke G.M. : Statistics and Experimental Design

but two were left over. The original intention was that each of the participating institutes (BARI, BRRI and BJRI) should have three books for their respective libraries. (Since the BARI library already has a copy of Clarke it should perhaps receive the one by Little and Hills.) It is understood that some other arrangement may be made as more suited to local needs.

Nevertheless, more books are needed. Possibilities are:

Snedecor G.W. and Cochran W.G.	-	Statistical Methods
Pearce S.C.	-	The Agricultural Field Experiment
Gomez K.A and Gomez A.A.	-	Statistical Procedures for Agricultural Research
Steel R.G.D. and Torrie J.H.	-	Principles and Procedures of Statistics
Finney D.J.	-	Statistics for Biologists
Draper N. and Smith H.	-	Applied Regression Analysis
Kempthorne O.	-	The Design and Analysis of Experiments.

There is also the question of journals. It is the custom of the Biometric Society to present back-numbers to institutes in less developed countries that wish to take its Journal. If it is decided to take advantage of that offer, application should be made to -

Professor P. Dagnelie
Faculty of Agriculture
Gembloux
Belgium.

If copies are desired for the future, the members of the team are willing to nominate some suitable person for membership of the Biometric Society. That person would then keep up-to-date and could pass copies of the journal to a library.

Other desirable journals are Experimental Agriculture and the Journal of Agricultural Science (Cambridge), if they do not already exist in local libraries.

Special Problems

With observers, some of whom fortunately did not attend, the numbers were greater than expected, and that led to a temporary shortage of books.

The trainees did not all arrive on time for the first lecture, which was of special importance, and it was further interrupted by the distribution of equipment.

Difficulties were also encountered from the unreliability of photocopying facilities.

Thanks

The team has greatly appreciated the positive friendliness and helpfulness of many people. They mention especially the staff of BARC and IADS in Dhaka, the staff at the BRRI hostel and many at BARI, notably Dr. S.M. Elias, Mr. Md. I. Hossain and Mr. Nuzrul Islam. They have especially valued the support of Dr. E. Ahsan and Dr. B.A. Greene of BARC.

Three Week Short Course on the Application of Statistics in Agricultural Research

1. Consultants: Dr. S C. Pearce - 26 years Director of Statistics Division, East Malling Research Station, Kent.
   - Dr. R.E. Kempson - Wye College, Kent
   - Mr. G.V Dyke · Director of Field Experiments, Rothamstead Exp. Station 20 + years. Part of Applied Statistical Research Unit, Univ of Kent, Canterbury, U.K.

2. Proposed Date:
   - Short Course: 22nd January - 8th February 1984
   - Team Arrival: 17th January 1984.

3. Location: BARI. Contact: Dr. S.M. Elias, A.E. Division

4. Housing : BARI Guest House
   19th January - 9th February
   - Dhaka Guest House
     17th,18th January and 9th February

5. Food : Daily lunch in BARI Canteen with participants
   - Breakfast, Dinner at Guest House

6. Transport: BARC/IADS to provide transport between: 17th January and 10th February as follows:
   (1) 17th-19th January or as long as the team stays in Dhaka City;
   (2) Take Team to BARI 19th January (or 20th/21st)
   (3) Thursday evening, Friday and Saturday of each week.

7. Practical Field Work
   - BARC/IADS to arrange with BARI to have field space and materials available for practical demonstrations during period of the course.
   - Mr G V. Dyke will send BARC a list of his requirements for this purpose.
   - BARC will confirm with BARI.

8. Future Trainers/Courses
   - A number of participants who perform well may be selected to assist or present future courses

- It is planned that Mr. G.V. Dyke, with support, may be able to set up a series of these courses using local personnel as lecturers
- The venue for such courses could be BARI, the Graduate Training Institute and regional centres.
- It is expected that these courses will fit into any scheme suggested by Dr. L. Nelson of North Carolina State University in statistics training at various levels. (Dr. Nelson cannot now come until July.)

9. Participants

- Maximum number: 30

  (1) Level 1 : 20 (Non-biometricians)
  (2) Level 2 : 10 (Biometricians)

- Institutions:

  BARI, BRRI, BJRI
  have all submitted candidates up to this moment.

- The course will have two streams:

  (a) Level 1 for field research personnel who are not biometricians and whose maths and statistics background is weak.

  (b) Level 2 for biometricians with a maths/statistical background

10. Course Materials

- Lecture materials will be sent by ASRU to BARC for duplication.
- A reference textbook, probably Little & Hill, will be ordered by IADS through Washington or carried by the Team from the U.K.
- All other materials will be supplied by
  (1) BARI: overhead projector, blackboard, microphone system
  (2) BARC: hand calculators, course paper, graph paper, pencils, pens, sharpeners.

11. Finances:

- Team consultancy fees to be determined between IADS/ Washington and ASRU, University of Kent.
- Local Costs to be included in AESS program budget as determined by IADS project leader and BARC/AESS.

12. Notices to Participants

- To be handled through BARC/AESS program Member-Director

13. Tentative Course Daily Schedule

8:00 am	Session 1
10:00 am	
	Tea
10:30 am	Session 2
12:30 pm	
	Lunch
2:30 pm	Session 3
4:30 pm	
	Dinner
	Homework

- Friday and Saturday no class
  Homework/exercises for Saturday
- Opening Ceremony 22nd January, BARI
- Closing Ceremony:
  Thursday 9th February Session 3
- Final Meeting with BARC/IADS 9th,10th February

14. Tentative Consultant Schedule

Tuesday 17th January arrive Dhaka BA 144

Wednesday, Thursday, Friday, Dhaka

Saturday move to BARI

Sunday 22nd January Course begins

Thursday 9th February end Course, return to Dhaka

Friday 10th February depart Dhaka BA 145

Participants in Course 22nd January - 8th February 1984

Bangladesh Agricultural Research Institute

1. Md Nowsher Ali Sarder, RARS, Jessore
2. Mr. Hinal Kumar Chowdhury, RARS, Ishurdi
3. Md. Fokhrul Islam, BARI
4. Md Nurul Alam, BARI
5. Mr. Malay Chandan Saha, RARS, Hathazari
6. Mr. Ramendra Kumar Paul
7. Mr S M. Nurul Islam, BARI
8. Mr. Abul Hashem, RARS, Hathazari
9. Md Abdul Quayyum, BARI
10. Md. Mizanur Rahman, RARS, Hathazari
11. Md. Mizanur Rahman, RARS, Jessore
12. Md. Jalal Uddin Sarker
13. Md Shamsuddin Alhamash
14. Kh. Saif Uddin
15. Mr. Anil Kumar Sen
16. Md. Mahbubur Rahman Khan
17. Md. Shamsuzzoha

CRWRC, Bogra

1. Mr. Nirmal Kumar Kar

Bangladesh Rice Research Institute

1. Mr. Malay Kumar De Amin
2. Mrs. Jannatul Ferdous
3. Mr. Gopal Krishna Bose

Bangladesh Jute Research Institute

1. Mr. S.A. Hashim
2. Md Abul Hossain
3. Md Abu Taher
4. Md. Abul Kalam Azad
5. Md. H.A. Sobhan
6. Mr P.B. Mandal

Second Short Course on the Applications of Statistics in Agricultural Research held at the Bangladesh Rice Research Institute, Joydebpur

10th-30th September, 1984.

by

S.C Pearce, G.V. Dyke and R.E. Kempson

Objectives and content of the course

The object of the course was to give instruction in the conduct of field experiments on crops, both from a theoretical and a practical point of view. Despite the fact that the group contained both agronomists and biometricians, all were expected to learn about such practical matters as the drawing of plans, the taking of records, estimations in the field, the harvesting of crops and the surveying needed to place the plots of the experiment correctly on the ground. In this connection it was noticeable that the participants appeared to have had little experience of this kind of work, essential though it is. For example no one knew how to use an optical square.

The greater part of the course, however, was given over to a systematic study of statistical methods of use in agricultural research. Thus the participants were introduced to the analysis of variance using the modern approach by sweeping whereby they became acquainted with the idea that each plot of an experiment makes its own contribution to error, a contribution that can sometimes be related to features of the land or mishaps in the conduct of the experiment They were then shown the older method of working out the analysis of variance using summation terms. Although shorter it does not isolate sources of error in the same way. Some attention was given to the use of blocks, rows and columns etc. to reducing experimental error, although warnings were given about their uncritical adoption.

Once the group was familiar with the basic approach they learned about the need to relate the design and interpretation of an experiment to the needs of the scientists. The approach required a clear statement in the form of contrasts that called for study. This was clearly novel for most of them and at first they found it difficult, but later they came to think readily along those lines. Once they could do so, they could see the weakness of the older approach using multiple comparisons e.g. Duncan's Multiple Range Test, with which they were already familiar. With contrasts clearly understood they were able to proceed to factorial designs e.g. m x n, m x n x p and 2^n systems, and to orthogonal polynomials for the study of increasing rate of application of fertilizer, fungicides etc. Later this part of the course was extended to cover confounding and the use of split plots.

The last part of the course dealt with a range of other techniques that derive from the analysis of variance, e.g. the analysis of covariance, bivariate analysis of variance and other techniques useful in the study of intercrops, both of these techniques being preceded by a brief look at correlation and regression for the sake of those who were beginners.

Towards the end the group was divided for two sessions between those who wished to know about series of experiments disposed over an area and those more interested in probit analysis, as used in laboratory experiments.

At several points in the course the group was divided into agronomists, who needed more practice at the statistical methods they had been taught, and biometricians, who could benefit from learning more advanced methods. The biometricians learned in particular about

the analysis of non-orthogonal data so that they could recover information in the event of an accident. They also learned about some of the useful non-orthogonal designs i.e. balanced incomplete blocks, simple lattices and designs with supplemented balance.

Towards the end the whole group was introduced to the problems of dealing with defective data, because it was intended that the course should be thoroughly practical and experiments are not always conducted perfectly despite care in avoiding errors.

Finally the participants were given a lot of practice in the writing of reports that should do justice to the analysis of data on which they were based, but should at the same time be clear and intelligible, leaving out nothing that the reader would reasonably expect to be told.

Other activities

Apart from teaching, the team was asked for advice on statistical matters by various people. In particular, Mr. Haque of BARI is writing a computer program to cope with data from unusual designs, including those that were originally of some conventional type but had suffered damage. It was a pleasure to have helped him in this admirable project.

The participants

Altogether there were 26 participants; two from Pakistan, one from Sri Lanka and 23 from Bangladesh. Those from Bangladesh included four from the Agricultural University, the rest coming from research institutes of the Agricultural Research Council of that country.

All were hard-working and cooperative. At first they found the course difficult and even daunting, but by the end of the second week they were more confident and more ready to express themselves.

The Sri Lankan unfortunately arrived a week late and was at a disadvantage thereafter in consequence.

On arrival each participant was provided with a hand-calculator and a copy of "Statistics and Experimental Design" by G.M. Clarke. At intervals during the course they were given duplicated copies of notes etc. provided by the team.

Accommodation

Both the team and the participants were accommodated very adequately at the Rice Research Institute, Joydebpur. Lectures were held at a nearby building, while the land round about was used for the occasional outdoor practice of recording and setting out an experiment in the field.

Working hours

It was intended that each working day should include three sessions of 90 minutes each and a fourth of 60 minutes. At first the hours were:

Session 1	9.00 am	to	10.30 am
Tea break	10.30 am	to	11.00 am
Session 2	11.00 am	to	12.30 pm
Lunch	12.30 pm	to	2.15 pm
Session 3	2.15 pm	to	3.45 pm
Tea break	3.45 pm	to	4.15 pm
Session 4	4.15 pm	to	5.15 pm

However this involved working through the heat of the afternoon. At the request of the participants, starting on 12th September hours were changed to:

Session 1	7.30 am to 9.00 am
Break	9.00 am to 9.20 am
Session 2	9.20 am to 10.50 am
Tea break	10.50 am to 11.10 am
Session 3	11.10 am to 12.40 pm
Break	12.40 pm to 1.00 pm
Session	1.00 pm to 2.00 pm

In general all da followed the same pattern. In each week Friday was a rest day when no work was required of the participants. For Saturdays 15 and 22 September they were given work to do by way of practice but Saturday 29 September was an ordinary working day. On each Thursday, Session 4 was used for a test, so that the team could judge how far the participants were gaining benefit from the course and also could detect those of special ability. Each evening the participants were given exercises to do. Mostly they turned in their work for inspection and that provided a further means of assessment. Each working day and also on Saturdays a member of the team was available from 8.00 pm to answer questions and resolve difficulties.

The only days when the above routine was broken were Sunday 9 September, when sessions 1 and 2 gave way to an opening ceremony, and Sunday 30 September when an excursion was organized to the Bangladesh Academy of Rural Development, Comilla.

Visits

On Wednesday 17 September two members of the team (GVD & REK) paid a visit to the Jute Research Institute Invitations were extended to the participants from outside Bangladesh but these were declined because those invited thought it important to stay with the class. The party was received with great cordiality. Both of those who went reported making useful contacts and learning a lot.

On Saturday 22 September the team together with the participants from Pakistan and Sri Lanka visited the Agricultural University at Mymensingh. The participants were shown round the University while the team spoke to staff of the Faculty of Agricultural Economics, the Librarian and some of the statisticians. Again one must record with appreciation the great cordiality and hospitality of the reception. The team made a number of suggestions about the books and journals of the library. They also discussed the syllabus of the M.Sc. course in Statistics and here also they had some suggestions to make.

Assessment of results

As has already been said, the team found the participants without exception to be hard working and well motivated. Naturally some did better than others, but all learned something.

Nevertheless questions remain about their former training. It is true that the course dealt with some modern techniques, for example calculating the analysis of variance by sweeping, bivariate analysis and the statistical treatment of intercropping generally. No one would expect the participants to know much initially about those topics, but much else in the course was more traditional and one must ask why instruction was necessary in topics like the analysis of covariance, split plot designs and other matters that are established technology. Participants in general knew little about such methods. Even with factorial design, which has been

a recognized form of experimentation for over forty years, they were ill-informed. If they knew how to analyse the data they were still unable to give a coherent account of the conclusions that should be drawn. The course was clearly needed, but it should not have been necessary.

The weaknesses were especially apparent in the group of biometricians, who were supposed to know more than the rest. While it is good for the experimenter in the field to know something about statistical methods, if experiment design and data analysis are to be soundly based and imaginative in spirit, there must also be those who have made a specialist study of such matters and are aware of all the techniques available, including the most modern. The team found little evidence that such people exist, judging at least by the participants from the three countries represented, some of whom were university teachers. The team believe that the course did give the 26 participants useful knowledge and extended their horizons, but it should not have been necessary to bring three consultants 6000 miles to do that. There should have been local people able to teach the course.

Part of the difficulty lies in the poor mathematical background of the participants. Of the ten who constituted the group of biometricians not one claimed any knowledge of matrix algebra. These days more advanced texts on statistical theory use matrix algebra rather than the more conventional scalar algebra that everyone knows. Consequently no person unskilled in it can aspire to read a modern text or a recent journal to keep abreast of developments. (It will be understood that these remarks apply to those who regard themselves as statisticians. An agronomist does not have to go into mathematical theory in the same way.)

When the team asked why there was a lack of basic training they were told that the calibre of those who sought training as statisticians was so poor that they could not embark upon the study of such

subjects. The team unhesitatingly rejected that judgement. They found the group of biometricians to be composed of intelligent people with a desire to learn. Given more time they could have taught matrices to the participating biometricians themselves. As it was, they could not go into proofs and demonstrations that would have deepened understanding, but were restricted to authoritative assertions with no justification of what they were saying. On a number of occasions the biometricians asked for proofs. Although the methods taught could all have been justified mathematically, it was not possible to do so with that group owing to their limitations. Nevertheless it was felt that both agronomists and biometricians had improved their understanding as a consequence of the course.

Second course on Applications of Statistics in Agricultural Research

Preliminary Programme

Essentially this is a modification of the first course, but with a little extra time. I have allowed longer coffee and tea breaks, again to avoid the sense of rush, even though that does mean finishing a little later. I propose

Session	I	09.00 am - 10.30 am
		Coffee
	II	11.00 am 12.30 pm
		Lunch
	III	02.15 pm - 03.45 pm
		Tea
	IV	04.15 pm - 05 15 pm

The one hour sessions are entirely practicals or tests. The longer ones do not have to be lecturing all the time

The syllabus has been slightly reduced with more time given to topics that we now see to be important, i.e. laying out an experiment in the field and the writing of reports.

The class would be divided in two ways, i.e.

A Agronomists

B Biometricians

and X,Y, being sub-sets at individual choice.

Monday, 10 September

I	ANOVA illustrated by sweeping	REK
II	Sources of experimental error	GVD
III	More ANOVA by sweeping	SCP
IV	Practice	

Tuesday, 11 September

I	Blocks, rows and columns	SCP
II	Drawing the plan	GVD
III	ANOVA by summation terms	REK
IV	Practice	

Wednesday, 12 September

I	A	The normal and other distributions	REK
	B	Non-orthogonality. The Kulper-Corsten iteration	SCP
II		Laying out an experiment 1	GVD
III		Contrasts	REK
IV		Practice	

Thursday, 13 September

I	A	Practice with ANOVA	REK
	B	The correlation matrix obtained by iteration	SCP
II		Laying out an experiment II	GVD
III		Orthogonal polynomials	SCP
IV		Practice or test	

Sunday, 16 September

I	A	Confidence limits of the mean	REK
	B	Balanced incomplete blocks	SCP
II		Plot sampling	GVD
III		m x n factorials	REK
IV		Practice	

Monday, 17 September

I	A	Practice with m x n factorials	REK
	B	Supplemented balance	SCP
II		Scoring and grading I	GVD
III		m x n x p factorials	SCP
IV		Practice	

Tuesday, 18 September

I	A	The t-test	REK
	B	The simple lattice I	SCP
II		Applying treatments in the field	GVD
III		What do we do experiments for?	SCP
IV		Practice	

Wednesday, 19 September

I	A	Practice with m x n x p factorials	REK
	B	The simple lattice II	SCP
II		Scoring and grading II	GVD
III		Introduction to correlation and regression	REK
IV		Practice	

Thursday, 20 September

I	A	More about correlation and regression	REK
	B	Multiple and partial regression	SCP
II		Writing the report I	GVD
III		Revision	
IV		Practice	

Sunday, 23 September

I		The 2^n factorial	REK
II		More about the 2^n factorial (incl. Yates's algorithm)	GVD
III	A	The analysis of covariance	REK
	B	The analysis of covariance	SCP
IV		Practice	

Monday, 24 September

I	X	Series of experiments I	GVD
	Y	Probit Analysis I	REK
II		Writing the report I	GVD
III		Intercropping I	SCP
IV		Practice	

Tuesday, 25 September

I	X	Series of experiements II	GVD
	Y	Probit Analysis II	REK
II		Transformations	SCP
III		Intercropping II	SCP
IV		Practice	

Wednesday, 26 September

I	X	Series of Experiments III	GVD
	Y	Probit analysis III	REK
II		Writing the report III	GVD
III		Intercropping III	SCP
IV		Practice	

Thursday, 27 September

I		Split-plots	REK
II		More about split-plots with standard errors	GVD
III		Intercropping	SCP
IV		Practice (or test)	

Monday, 30th September

I	A	Defective data I	GVD
	B	Defective data I	SCP
II		Writing the report IV	GVD
III		Revision	As needed
IV		Practice	

Tuesday, 1 October

I	A	Defective data II	GVD
	B	Defective data II	SCP
II		Revision	As needed
III		Question session	all

Participants in course 10th-30th September 1984

PAKISTAN

1.	S. Zahid Mustafa	Stat. Officer (Wheat Programme)
2.	Mr. Habibullah Khan	Stat. Officer (Animal Hus.Div.) PARC, Islamabad.

SRI LANKA

1.	S. Balendra	Dept. of Agriculture Peradeniya, Sri Lanka.

BANGLADESH

Bangladesh Jute Research Institute

1.	Mr Azimuddin Ahmed	SSO, (Bot. Div.)
2.	Mr. F.A.H. Talukder	SSO, (Agro.Div)
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