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I. BACKGROUND AND JUSTIFICATION

When the competitive position of manufacturing enterprises in Brazil is rated against their international counterparts on measures such as consumer satisfaction, ability to overcome non-tariff export barriers, labour productivity and capital utilization rates, many enterprises in Brazil are not highly competitive in their international markets.

Several reasons may be given for the high levels of industrial development of the industrialized countries and of the few Asian NIEs. While the state of technology and economies of scale are clearly important, an equally crucial factor has been the adoption of modern managerial methods. Focusing on product quality, unit cost, and timely product development and delivery, the new methods are often referred to as "total quality management". Central to this approach is the application of analytical statistical tools, e.g., statistical process control, design of experiments, etc. Timely development, cost reduction, and the removal of flaws are all key factors in obtaining larger shares of international markets.

Few Brazilian organizations have the capability to act as multiplers of the new methodologies and there are few professionals who can help Brazilian firms to internalize these modern productivity and quality control techniques. The persistence of such human resource scarcity has resulted in a widening competitive gap between Brazilian and foreign industry.

Two years ago, in recognition of the importance of total quality management methods, the Brazilian Government, with participation of the World Bank, launched a programme for introducing quality management methods. Three institutions were identified as regional management centres; one located in Rio de Janeiro, one in Minas Gerais, and one in Sao Paulo. It is The Carlos Alberto Vanzolini Foundation (FCAV) of Sao Paulo that is the focus of this proposal. In carrying out its obligations under the national programme, FCAV arranged for several members of its management nucleus and associates of multiplier institutions to attend a seminar on aspects of total quality management at a leading management development centre in the United States.

At this stage, the Government now recognizes the importance of strengthening and institutionalizing the relationship between FCAV and a counterpart or counterparts in a highly industrialized country. Such a relationship will establish a conduit for the continuous and timely trans.er of new developments in managerial technology. Accordingly, the government of Brazil has requested UNIDO for technical assistance in implementation of a pilot seminar on managerial and organizational development of Brazilian manufacturing firms - a pilot project for its envisaged long-term project of establishment of an International Centre for Improvement of Human Resources in the Field of Quality and Productivity - through the Resident Representative of UNDP in Brazil on 6 September 1989.

II. THE PROJECT

(a) Project Objective

Establishment of an International Centre for Improvement of Human Resources in the Field of Quality and Productivity (ICAQP) will have two

phases: a Pilot Project and definitive establishment of ICAQP. The proposed project refers to the first phase, i.e., the Pilot Project.

The general objective of the establishment of ICAQP is to serve national as well as regional firms, regardless of industrial sector or firm size. The ICAQP is envisaged as a continuing joint venture between FCAV and a major foreign management centre. Its goal is to maintain a permanent conduit for continuous transfer of the evolving aspects of total quality management. To help facilitate that goal, it should maintain a board of advisers consisting of the respective academic deans of engineering and business management of the partner institutions, top executives of manafacturing enterprises and representatives from UNIDO and CEPAL (ECLA). The fundamental responsibility of ICAQP will be the development and presentation of programmes for the dissemination of the new managerial/organizational techniques such as statistical process control (SPC), total quality control, design of experiments, international logistics and in-plant implementation of quality and productivity methods.

The long-run goal of ISAQP will have a regional orientation, being intended to meet the needs of manufacturers throughout Latin America.

The immediate objective of the pilot project is to demonstrate to Brazilian industrialists and government officials the importance of organizing the operations of manufacturing firms in a manner that incorporates these modern approaches that involve the application of statistical techniques to production line processes, product design, cost management, logistics, marketing, etc. The proposed pilot project intends to show managers of Brazilian manufacturing firms and government officials how these approaches can be useful and how they can be applied by having them work through several case studies.

In collaboration with the Carlos Alberto Vanzolini Foundation (FCAV), a non-profit organization created and operated by the faculty of the Department of Production Engineering of the Polytechnic School of the University of Sao Paulo, who will place its structure, personnel and facilities in support of the realization of the pilot project, international specialists from the subcontracting management center will conduct the seminar in Sao Paulo.

(b) Outputs

   Output 1. Training material for a pilot seminar on the selected techniques i.e., SPC and total quality control in English and Portuguese for senior and middle-level managers of Brazilian firms*.

   Output 2. A seminar carried out jointly with international experts and staff of local facility (i.e., FCAV) on application and use of the selected methods among Brazilian firms.

   Output 3. A brief project report (e.g., 30 double-space typed-manuscript pages) on evaluation of the pilot seminar and recommendations for the establishment of ICAQP.

_____

* UNIDO will prepare, prior to the project, an original English version of the training material.

The total subcontracting cost is estimated to be US$39,294, which includes the following cost components:

			US dollars
(i)	Visit of three specialists from the sub-contracting institution to FCAV for 10 days:		
	Flight ($2,400 x 3)	$7,200	
	Terminal expenses ($24x2x3)	144	
	DSA ($145x3x10)	4,350	11,694
(ii)	Materials (texts, translation, and reproduction of cases, hand calculations, etc.)		4,100
(iii)	Simultaneous translation		3,000
(iv)	Facilities, reception, coffee breaks, logistics		4,500
(v)	Other costs (lecturer fees, administrative overhead, etc.) ($8,000 x 2 mos.)		16,000
	TOTAL subcontracting cost		$39,294

UNIDO staff mission

The project will require a 10-day mission of one UNIDO staff member to Sao Paulo [see Activities 2.1.3, 2.1.4 and 2.1.5 listed in II(c)]. The travel cost is estimated to be US$5,198.

(c) Activities

Activities ( ): location	To be completed by working day	Parties responsible for activity
For Output 1:		
1.1.1. Modify and finalize course material at the home base of the sub-contracting institution	10	Two faculty members of FCAV, subcontracting institution
1.1.2. Translate and print course material (Sao Paulo)	10	Subcontracting institution

For Output 2:

2.1.1.	Training of two FCAV lecturers (i.e., the two FCAV faculty members who would be responsible for Activity 1.1.1) with a one-week training course at the home base of the subcontracting institution during the Activity 1.1.1.	5	Subcontracting institution
2.1.2.	Select participants and distribute course material (Sao Paulo). (This activity will be carried out simultaneously with Activity 1.1.2.)	10	Faculty of FCAV
2.1.3.	Set up curriculum and schedule of the seminar (Sao Paulo)	5	3 specialists from the subcontracting institution, Faculty of FCAV, one staff member of UNIDO
2.1.4.	Conduct a 5-day pilot course for training managers of Brazilian manufactauring firms (Sao Paulo). It is likely that simultaneous translation of lectures would be required	5	3 specialists from the subcontracting institution, Faculty of FCAV, one staff member of UNIDO
2.1.5.	Conduct a 3-day conference, following 2.1.4., of all participants of the pilot course to evaluate the pilot course (Sao Paulo) During this conference, the objectives and ideas of the envisaged long-term project for ICAQP will be explained and, if deemed desirable, plans for the long-term project will be laid.	3	3 specialists from the subcontracting institution, Faculty of FCAV, one staff member of UNIDO

For Output 3:

3.1.1.	Write a report on evaluation of the seminar (2.1.4 and 2.1.5) and recommendations for the long-term project based on conclusions drawn from the experience gathered under 2.1.4 and 2.1.5.	12	Subcontracting institution in collaboration with faculty of FCAV

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(d) Inputs

(i) Government Inputs in Kind:

- The FCAV will provide for local input in the preparation of training materials and project administration.

- Salaries of national staff to participate in the development of training material and carrying out the seminar.

(ii) UNIDO Inputs:

Subcontracts:

UNIDO would subcontract the responsibilities for the activities 1.1.1., 2.1.1., 2.1.3., 2.1.4., 2.1.5., and 3.1.1.

The subcontractor should be a managerial institute that has ample experience and high credibility in training and technology transfer in the field of managerial and organizational methods in question and provides one-week training course relevant for Activity 2.1.1. One of the most reputable institutes is the Management Development Center (MDC), the University of Tennessee, Knoxville, USA. MDC has expressed interest in transferring its knowledge and experience to developing economies. Furthermore, the government of Brazil intends to co-operate jointly with MDC in its envisaged long-term project of the establishment of ICAQP.

Equipment and supplies

No acquisition of equipment is contemplated.

III. REPORTING AND EVALUATION REQUIREMENTS, EXPECTED FOLLOW-UP

Seminar experience would be critiqued and consolidated. A draft project report will be reviewed before its finalization.

Expected follow-up would be to extend the scope of work to include other related managerial tools. A long-term project on managerial methods (e.g., the envisaged project for the establishment of ICAQP) would be the outcome. Ultimately, similar seminars would be designed and offered in several other Latin American countries based on the experience gathered during this project.

A Brazilian company manufactures consumer products which are the high end of the market as regards image, price, and margin. Senior executives anticipate that several of these products will encounter increased competitive pressures over the next few years from both domestic and foreign firms.
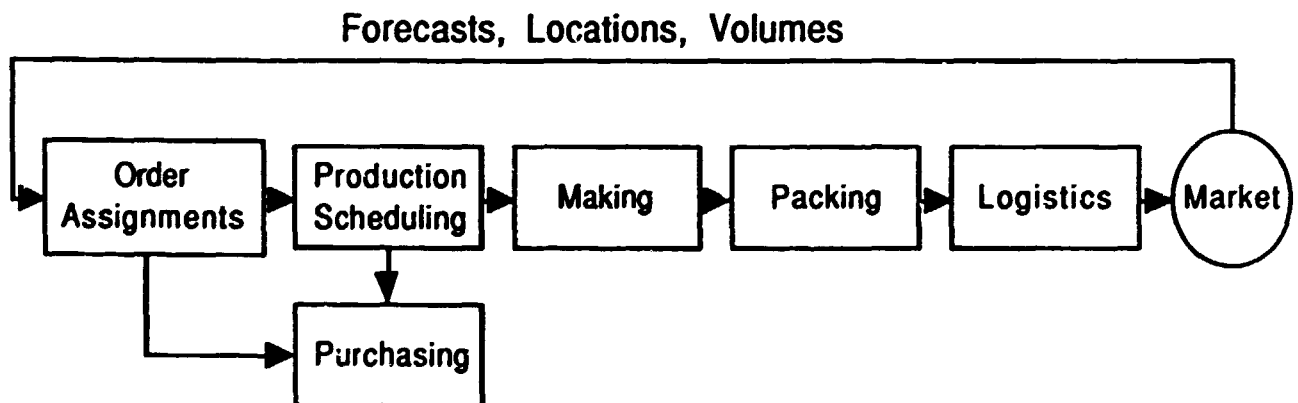
The seniors conclude that value will be interpreted by the consumers in some uneasy combination of price, quality, availability, and consistency. The seniors decide that the firm will remain a leader in these markets by providing for increased value and that margins will not be reduced to accomplish this objective. These executives have assumed the responsibility of identifying the critical systems which must be improved in order to provide quality, consistency, and availability at selected prices. Ownership and responsibility for crucial systems has been assigned to individual members of the senior management team.

To help focus on what must be done, a critical product, cologne, is selected for specific evaluation. Proactive marketing work in retail outlets and in the distribution chain reveals that product quality is consistent and meets current consumer expectations. However, it is found that the volume of product delivered in a container is variable and erratic; this is potentially troublesome because it is known that consumers will make comparisons regarding quantity.

It has been found that the legal requirement of a fill of no less than 123.5 milliliters is safely met, indeed largely exceeded. This is confirmed by manufacturing records. A financial person in the group reminds everyone that this product line is known to consistently exceed material allowances.

It is also found that the product is not always available in the retail outlets. These outlets are typically small, located in exclusive shopping areas and, in accordance with recently adopted practices, prefer not to be a storage location for the product. Further investigation reveals that the distribution chain suffers from periodic stockouts of this and other products.

Overpack numbers and quantity variations relate to possible consumer acceptance; budget variances on material relate to cost and to margin. Unreliable availability suggests weak manufacturing reliability and possible breakdowns at other system junctures. Attention is directed toward that system which ties market forecasts, volume, and location needs into production assignments, correlates purchasing with the production schedule, and relates manufacturing capability and run times with distribution and storage practices and capabilities.

Forecasts, Locations, Volumes

Order Assignments → Production Scheduling → Making → Packing → Logistics → Market

Order Assignments → Purchasing
Production Scheduling → Purchasing

The manager responsible for that system assigns part of the work to specific management groups. Manufacturing capability is assigned to the logistics manager who hands off to the plant managers. At one of the plants, where this story begins, the plant manager assigns the task to the manufacturing head who posts it to a shift supervisor who assigns Jose' and Ronaldo to find out about the overpack situation. Jose' and Ronaldo have done this before for QC.

The packing machine has four heads and typically runs across two shifts. The technicians select two containers from the line twice each shift and determine the net contents of each. Averages and ranges for each subgroup are reported on the next page.

Do you judge the packing process to be in control?

Day	Net Contents		$\overline{X}$	R
1	126.10	126.70	126.4	0.6
1	125.30	126.50	125.9	1.2
1	126.40	126.40	126.4	0.0
1	130.95	123.85	127.4	7.1
2	127.25	126.95	127.1	0.3
2	125.80	126.20	126.0	0.4
2	126.65	126.35	126.5	0.3
2	129.50	124.10	126.8	5.4
3	125.35	125.65	125.5	0.3
3	130.00	128.00	129.0	2.0
3	127.75	128.05	127.9	0.3
3	124.85	125.15	125.0	0.3
4	128.20	128.00	128.1	0.2
4	126.65	128.35	127.5	1.7
4	128.45	128.55	128.5	0.1
4	127.30	123.70	125.5	3.6
5	127.75	127.65	127.7	0.1
5	125.90	126.90	126.4	1.0
5	128.00	128.40	128.2	0.4
5	128.65	128.55	128.6	0.1
6	126.60	126.60	126.6	0.0
6	124.95	125.05	125.0	0.1
6	128.05	127.95	128.0	0.1
6	131.05	126.75	128.9	4.3
7	127.85	128.15	128.0	0.3
7	127.95	126.65	127.3	1.3
7	127.10	127.90	127.5	0.8
7	129.65	123.55	126.6	6.1
8	128.20	128.60	128.4	0.4
8	125.30	124.90	125.1	0.4
8	127.50	127.70	127.6	0.2
8	125.50	126.90	<u>126.2</u>	<u>1.4</u>

$$\Sigma\overline{X} = 4060.6 \qquad 40.8 = \Sigma R$$

Worksheet for $\overline{X}$ and R Charts

$$\overline{R} = \frac{\text{Sum of ranges}}{\text{Number of ranges}} \qquad \begin{array}{l} UCL_R = D_4\overline{R} \\ LCL_R = D_3\overline{R} \end{array}$$

$$\overline{X} = \frac{\text{Sum of } \overline{X} \text{ values}}{\text{Number of } \overline{X} \text{ values}} \qquad \begin{array}{l} UCL_{\overline{X}} = \overline{\overline{X}} + A_2\overline{R} \\ LCL_{\overline{X}} = \overline{\overline{X}} - A_2\overline{R} \end{array}$$

The number of items in each subgroup = n = **2**

$D_3 =$ **None** $A_2 =$ **1.880**
$D_4 =$ **3.267**

R Chart:

① Sum of ranges for subgroups **40.8** ÷ Number of subgroups □ = $\overline{R}$ □

② D_4 □ × $\overline{R}$ □ = UCL_R _____

③ D_3 □ × $\overline{R}$ □ = LCL_R _____

Note: Do not proceed to $\overline{X}$ chart unless R chart is in control.

$\overline{X}$-Chart:

④ Sum of $\overline{X}$ Values **4060.6** ÷ Number of $\overline{X}$ Values □ = $\overline{\overline{X}}$ □

⑤ A_2 □ × $\overline{R}$ □ = ⟶ [result is $A_2\overline{R}$]

⑥ x▸M ⟶ [this puts $A_2\overline{R}$ into memory]

⑦ $\overline{\overline{X}}$ □ + RM = $UCL_{\overline{X}}$ _____

⑧ $\overline{\overline{X}}$ □ − RM = $LCL_{\overline{X}}$ _____

A Machine With Four Heads

R Chart

$UCL_R = 4.165$

$\overline{R} = 1.275$

SAMPLE NUMBER

$\overline{X}$ Chart

$\overline{\overline{X}} = 126.894$

SAMPLE NUMBER

Frequency

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
3.	4.	4.	4.	5.	5.	6.	6.	6.	7.	7.	8.	8.	8.	9.	9.	0.	0.	0.	1.
6	0	4	8	2	6	0	4	8	2	6	0	4	8	2	6	0	4	8	2
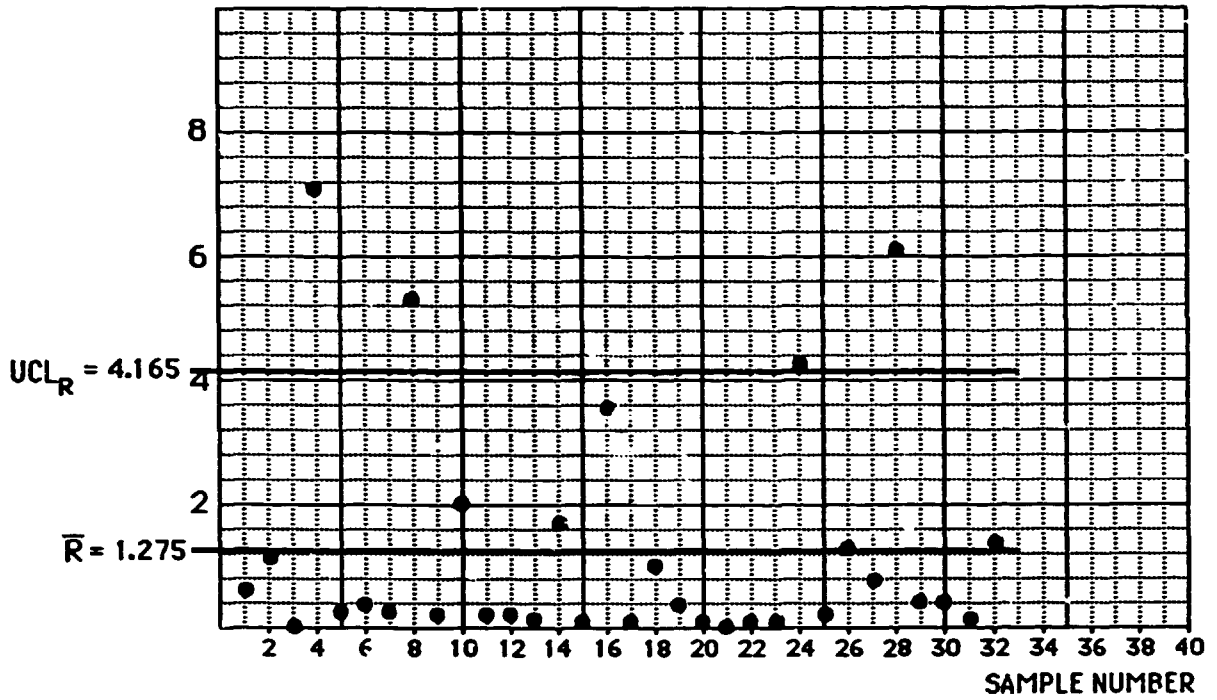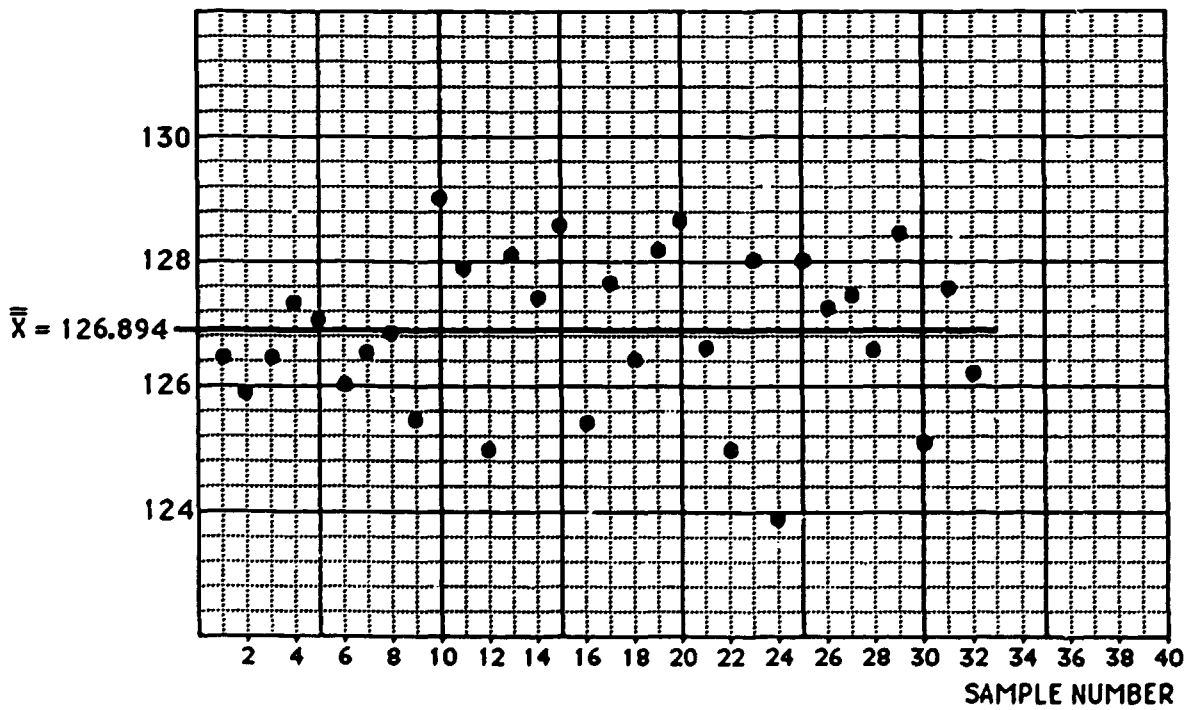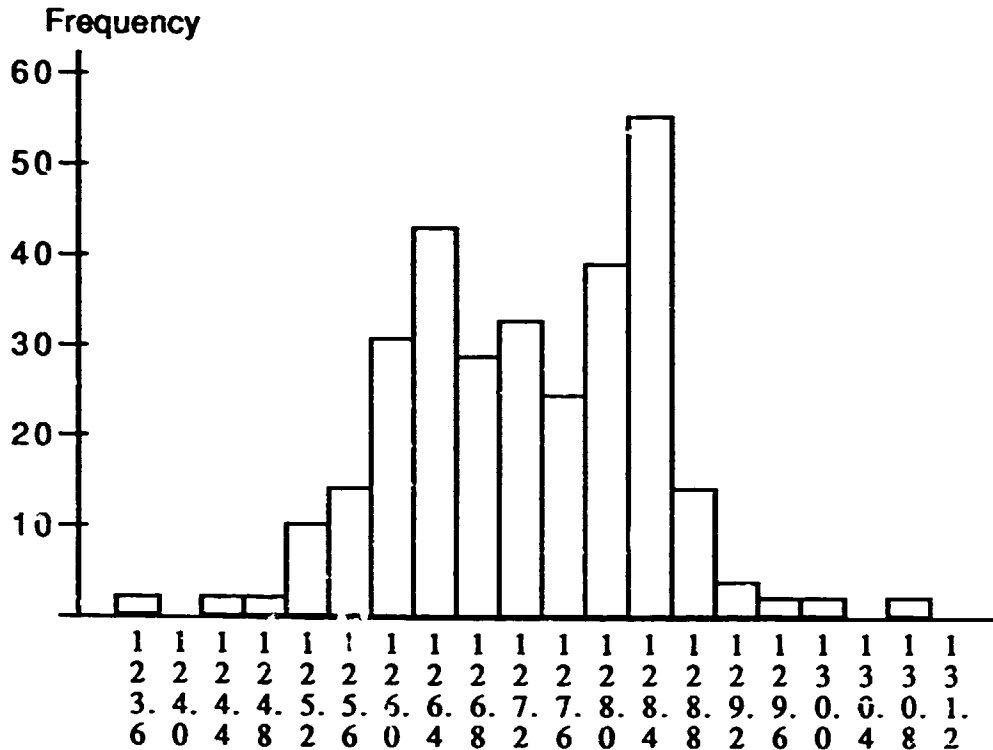
In response to a request for more information, other
measurements are collected and a histogram formed. Is the
above histogram useful to you? Would you want to replicate
this histogram? Would you want to change this histogram? In
what respect?

I.   Do you agree with the sampling strategy?

II. What should be the sampling strategy? To do what?

Some Examples of Process Behavior
for Each Head

Time
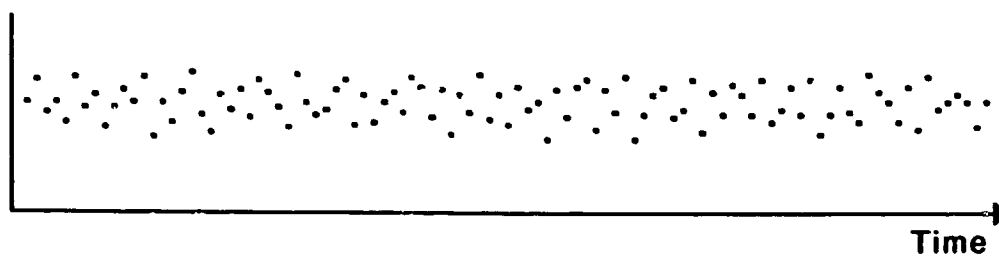
Consistent variation, consistent average

Time
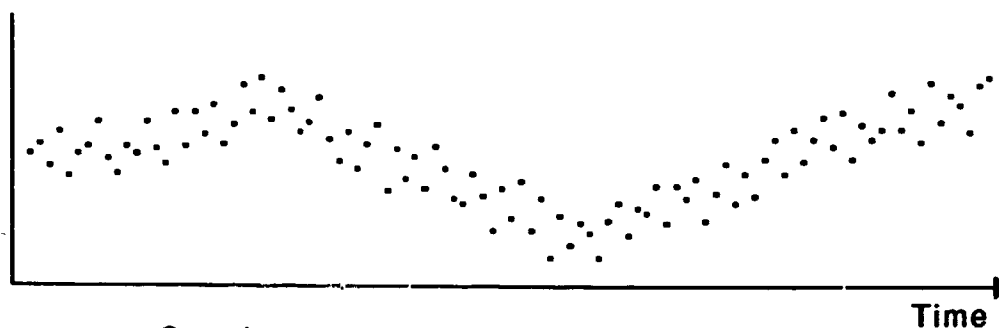
Consistent variation, changing average

Time
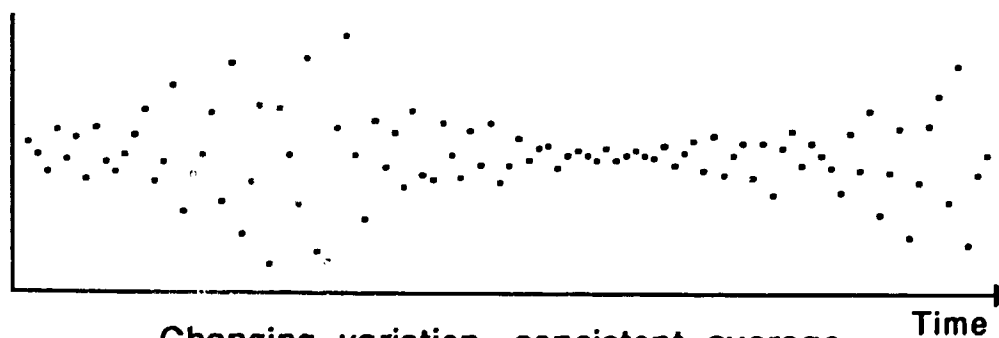
Changing variation, consistent average

Time
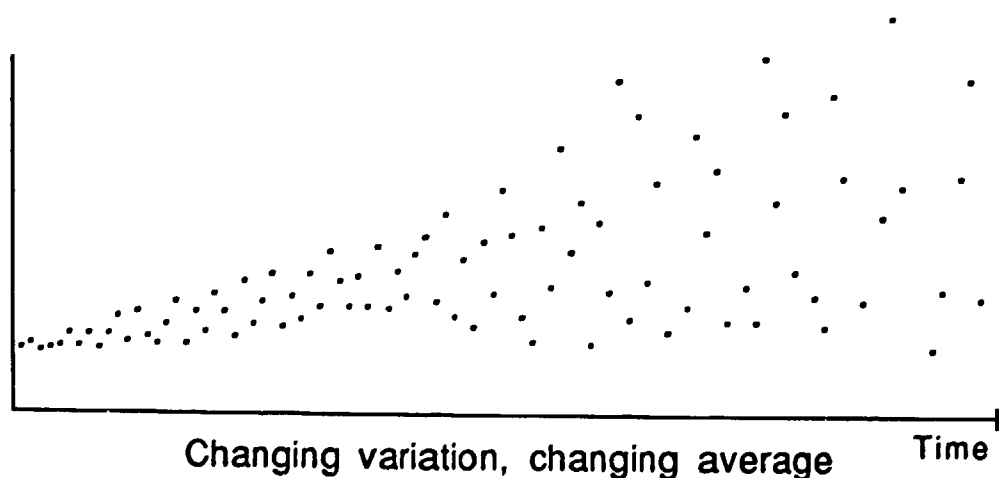
Changing variation, changing average

Information Needed:

- Within head variability
    stability
    magnitude

- Comparison of within head variations

- Within head averages
    stability
    magnitude

- Comparison of variation among heads: do heads have the same average?

- Comparison of average and variability to process/product needs:
    label weight
    material variances (budget)
    consistency in quantity delivered
    improvement

Suppose this process were sampled:
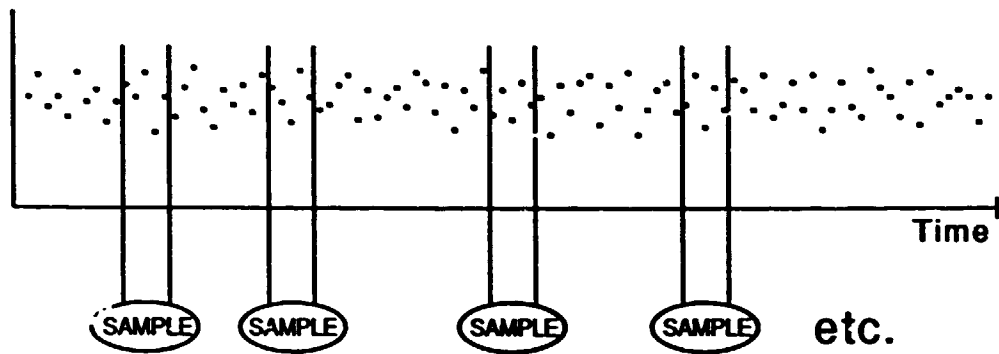
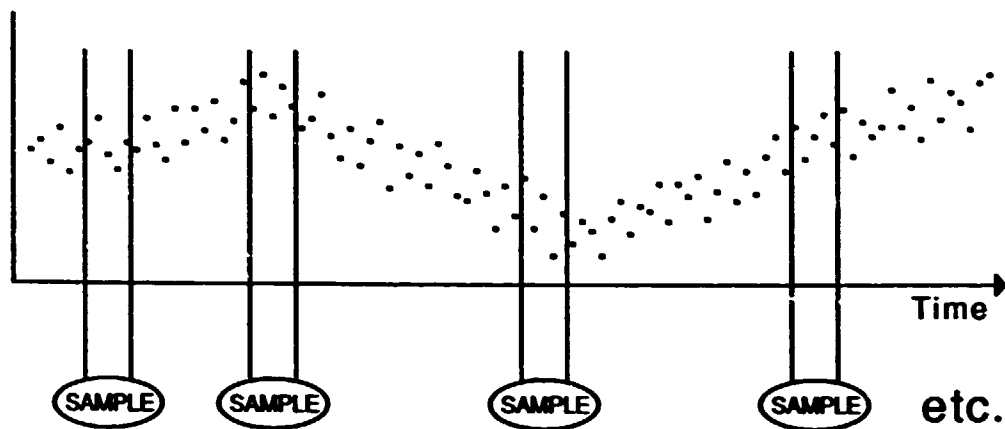# We would expect to see:
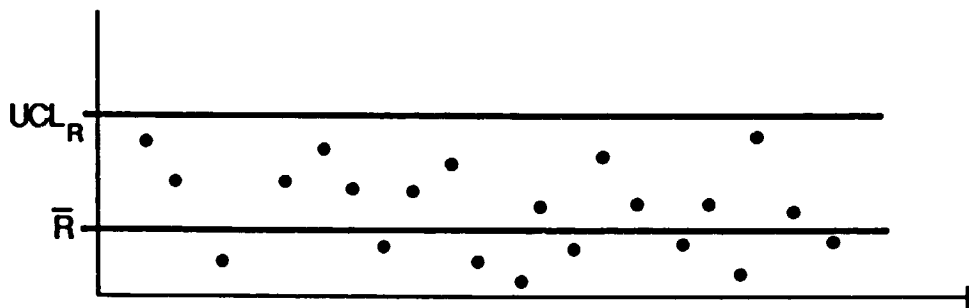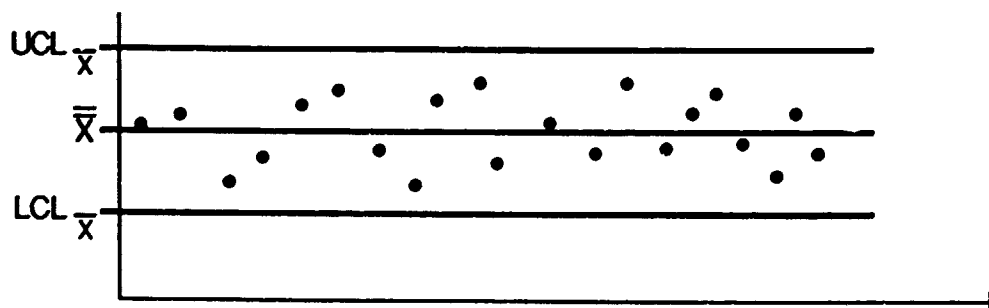
R chart

$\overline{X}$ chart

Instructor: Please be sure to draw lines from the "sample" bubbles to the dots on the chart like this:
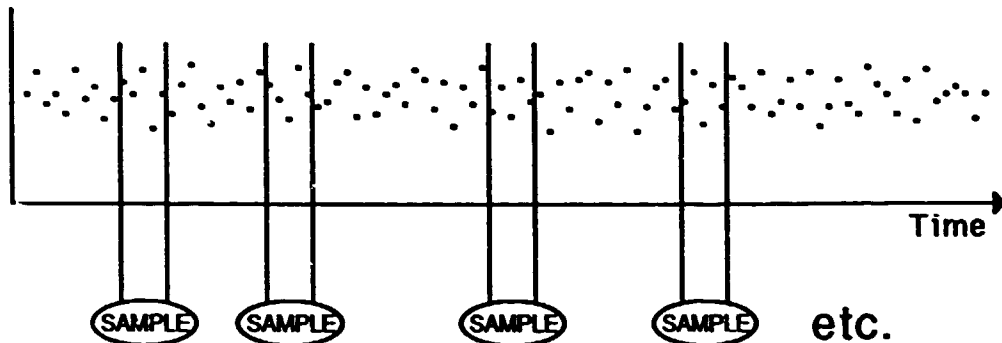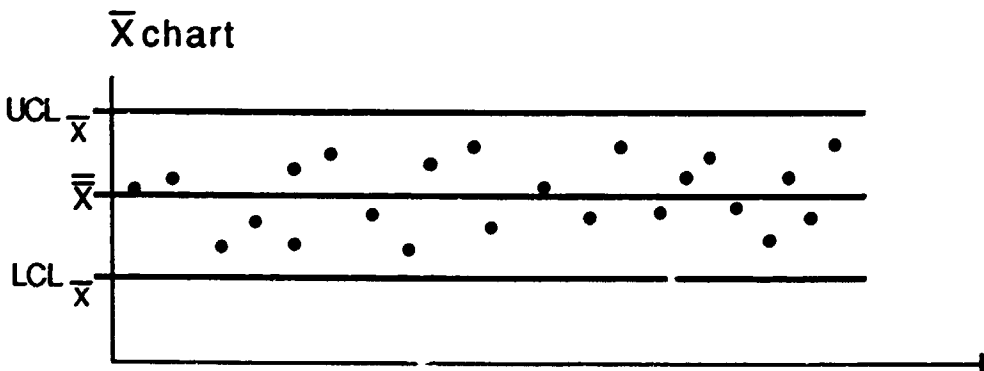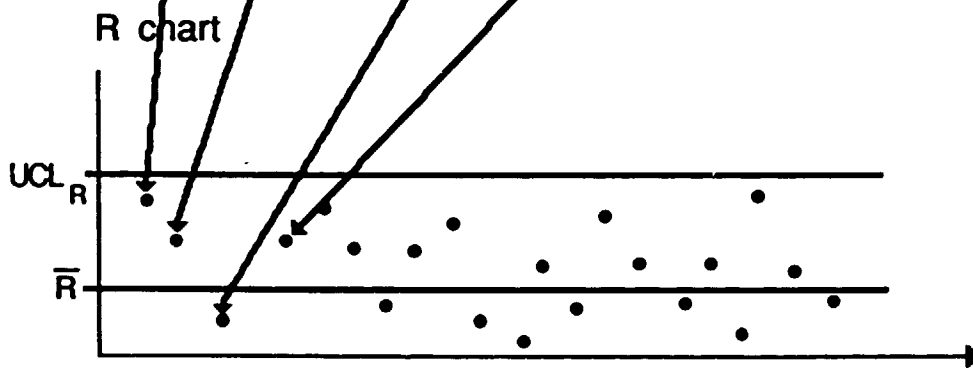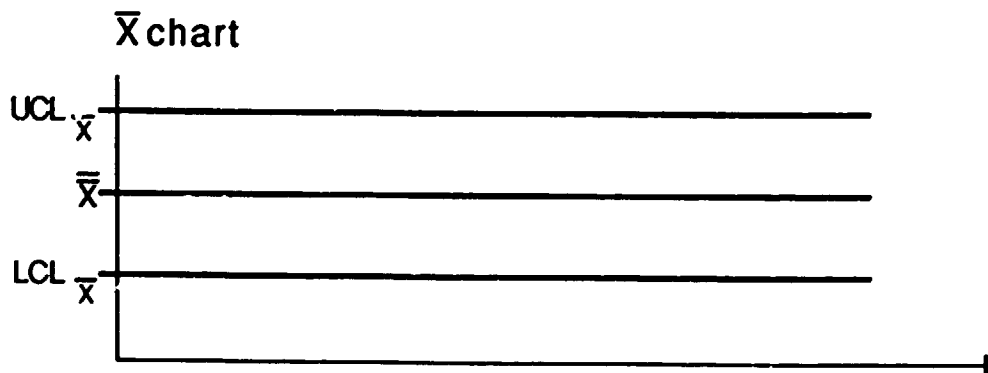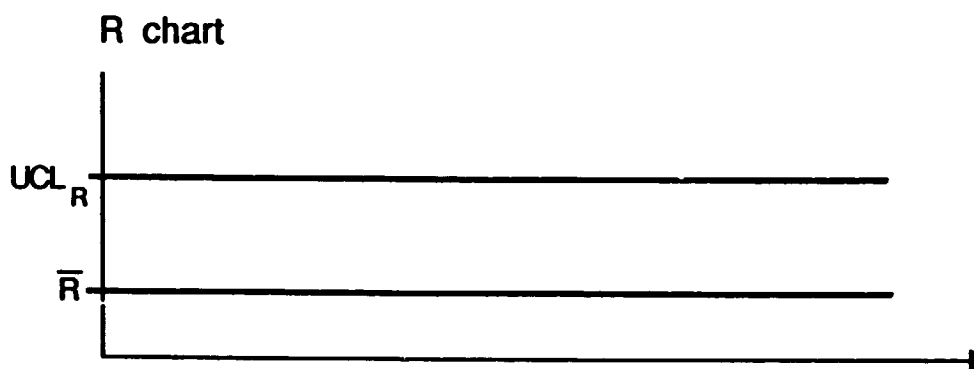
Suppose this process were sampled:
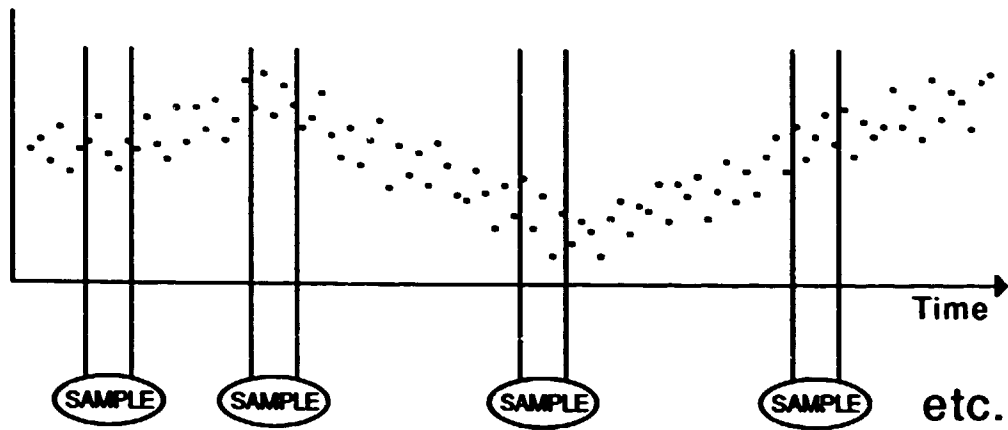
We would expect to see:

R chart

$\overline{X}$ chart

Suppose this process were sampled:

Time

SAMPLE **SAMPLE** **SAMPLE** **SAMPLE** etc.

We would expect to see:

R chart

UCL_R

$\overline{R}$

$\overline{X}$ chart

$UCL_{\overline{X}}$

$\overline{\overline{X}}$

$LCL_{\overline{X}}$

Suppose this process were sampled:

We would expect to see:

R chart

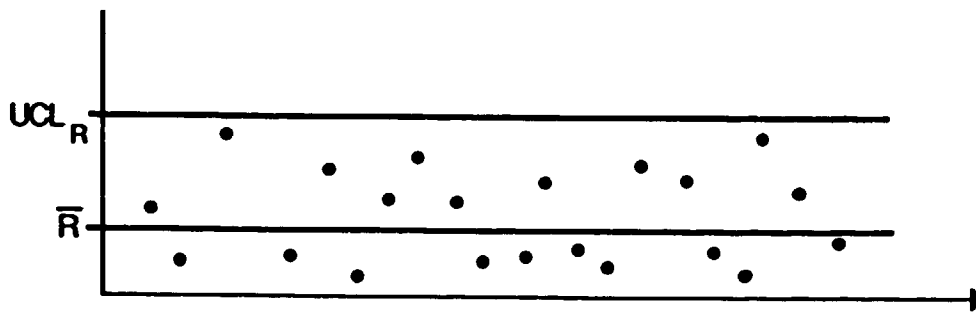# Suppose this process were sampled:

We would expect to see:
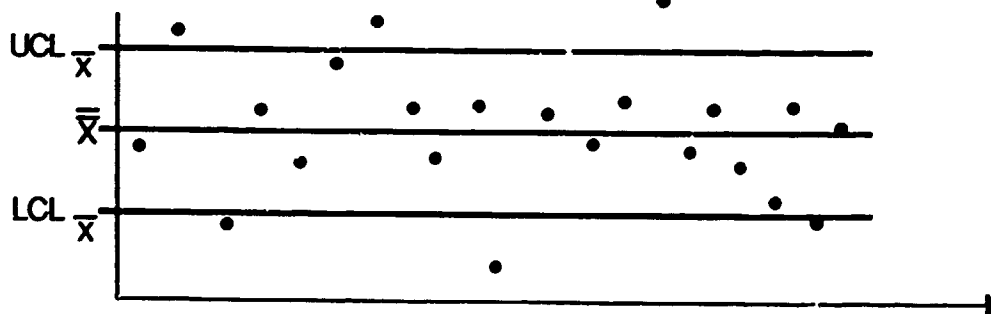
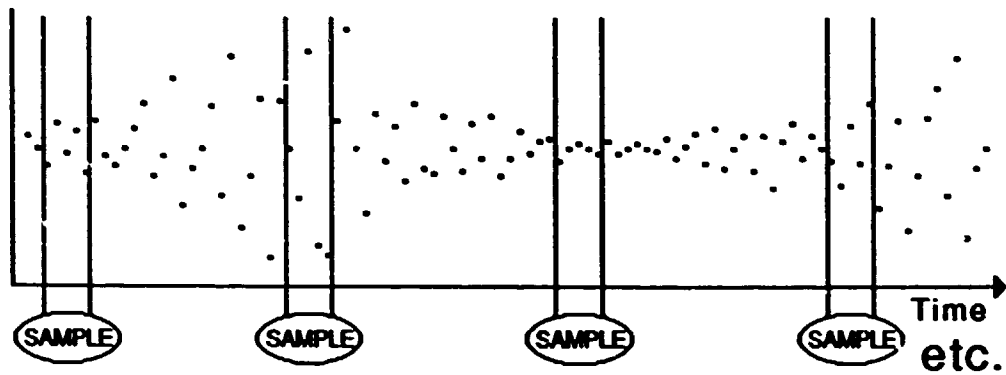### R chart

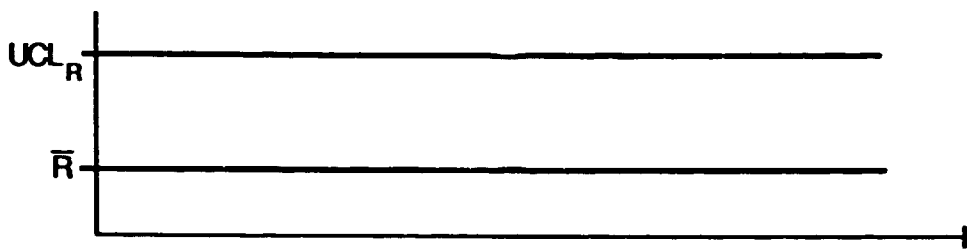# Suppose this process were sampled:

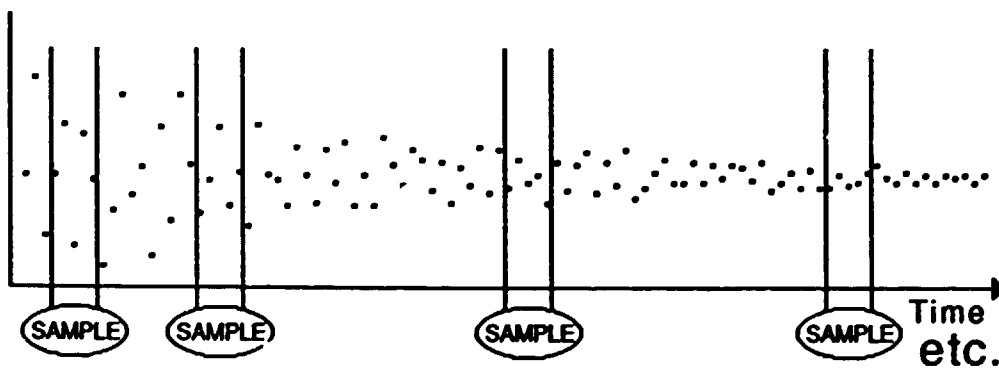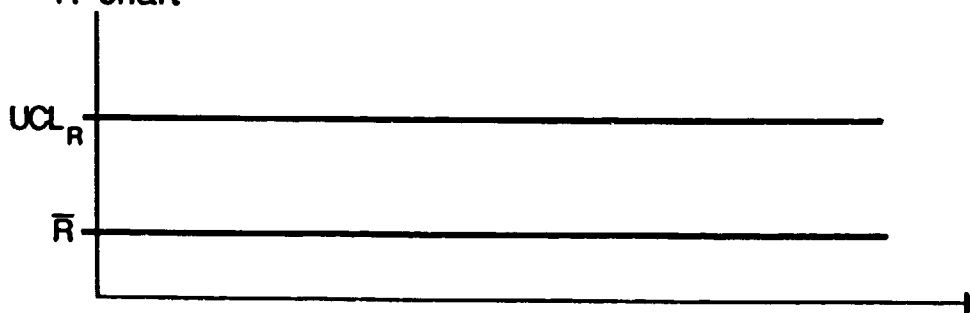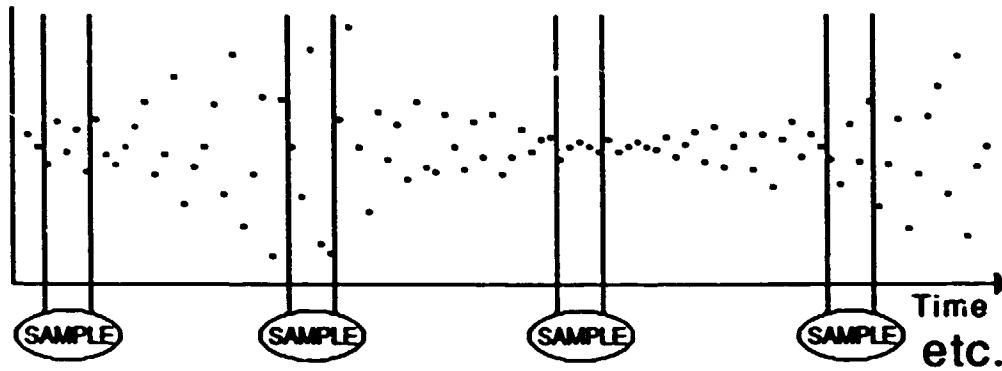
etc.

We would expect to see:

R chart

Suppose this process were sampled:

etc.
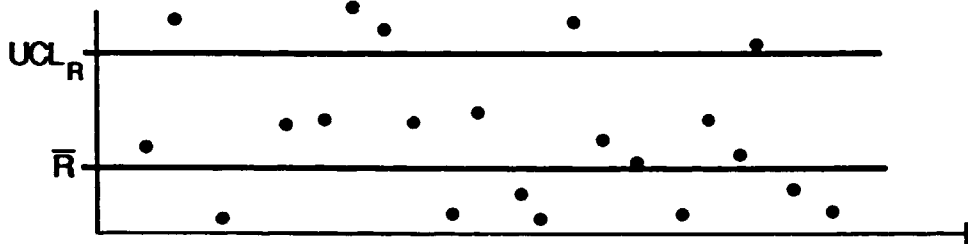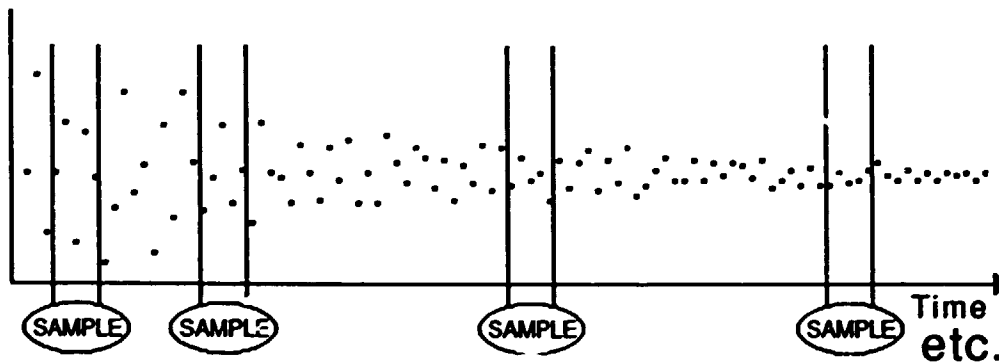
We would expect to see:
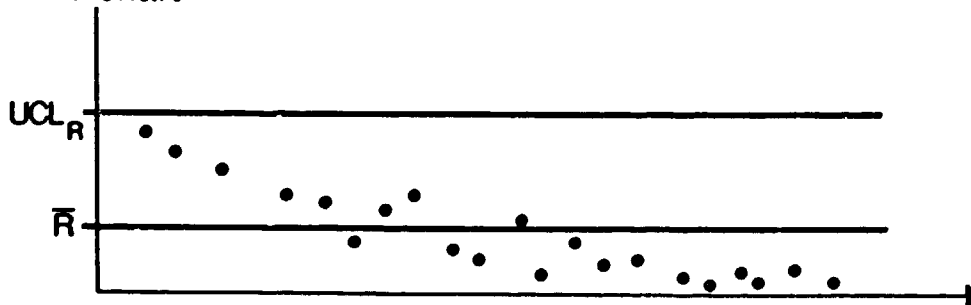
R chart

Instructor:

The group should come away from the previous 3 pages with something more than insights on X-bar and R chart pairs. They should understand:

1) The critical importance of system/process knowledge on the part of the person deciding on a sampling or subgrouping scheme.

2) The importance of purpose in the determination of a sampling strategy. The sampling which would be appropriate for control of a process might be different from the sampling for study of that process to increase our knowledge of that process. Both might be different from sampling to characterize the output of that process.

Coverage of the previous 3 pages shouldn't consume a lot of time, except as it focuses on the impact of sampling. They have already spent time on looking at graphs like these and thinking about the X-bar and R charts.

Subgroup Ranges
for Net Contents on Two Consecutive Containers
- Further Analysis -

Data are collected by determining the net contents of two consecutive containers from the same head. Head number and shift number are maintained. Ranges are reported on the next page. Complete an appropriate analysis and provide an interpretation of the chart.

What are the consequences regarding material use and quantity delivered to the customer?

| Subgroup	Head	Shift	Net Contents		R
1	1	1	126.72	126.12	0.6
2	2	1	125.42	125.82	0.4
3	3	1	126.43	126.53	0.1
4	4	1	124.38	126.78	2.4
5	1	2	126.88	125.88	1.0
6	2	2	125.99	125.59	0.4
7	3	2	126.17	127.07	0.9
8	4	2	128.14	122.74	5.4
9	1	1	126.28	126.58	0.3
10	2	1	124.75	125.45	0.7
11	3	1	126.27	126.57	0.3
12	4	1	125.89	125.79	0.1
13	1	2	126.02	126.72	0.7
14	2	2	126.49	124.79	1.7
15	3	2	126.28	126.68	0.4
16	4	2	127.33	123.73	3.6
17	1	1	126.29	126.39	0.1
18	2	1	125.71	126.01	0.3
19	3	1	126.64	126.24	0.4
20	4	1	125.85	125.85	0.0
21	1	2	126.34	126.44	0.1
22	2	2	125.22	125.32	0.1
23	3	2	126.62	126.42	0.2
24	4	2	123.23	127.53	4.3
25	1	1	126.43	126.73	0.3
26	2	1	125.92	125.52	0.4
27	3	1	126.01	126.81	0.8
28	4	1	124.84	126.84	2.0
29	1	2	126.00	127.20	1.2
30	2	2	126.12	125.72	0.4
31	3	2	126.95	126.45	0.5
32	4	2	126.24	124.84	1.4
33	1	1	126.06	127.06	1.0
34	2	1	125.62	125.82	0.2
35	3	1	126.95	126.35	0.6
36	4	1	125.42	125.82	0.4
37	1	2	124.77	127.77	3.0
38	2	2	125.50	125.00	0.5
39	3	2	125.81	126.61	0.8
40	4	2	124.11	127.01	2.9

$$\overline{R} = 1.023 \qquad UCL_R = 3.267(1.023) = 3.342$$

R Chart for Two Consecutive Containers

SAMPLE NUMBER
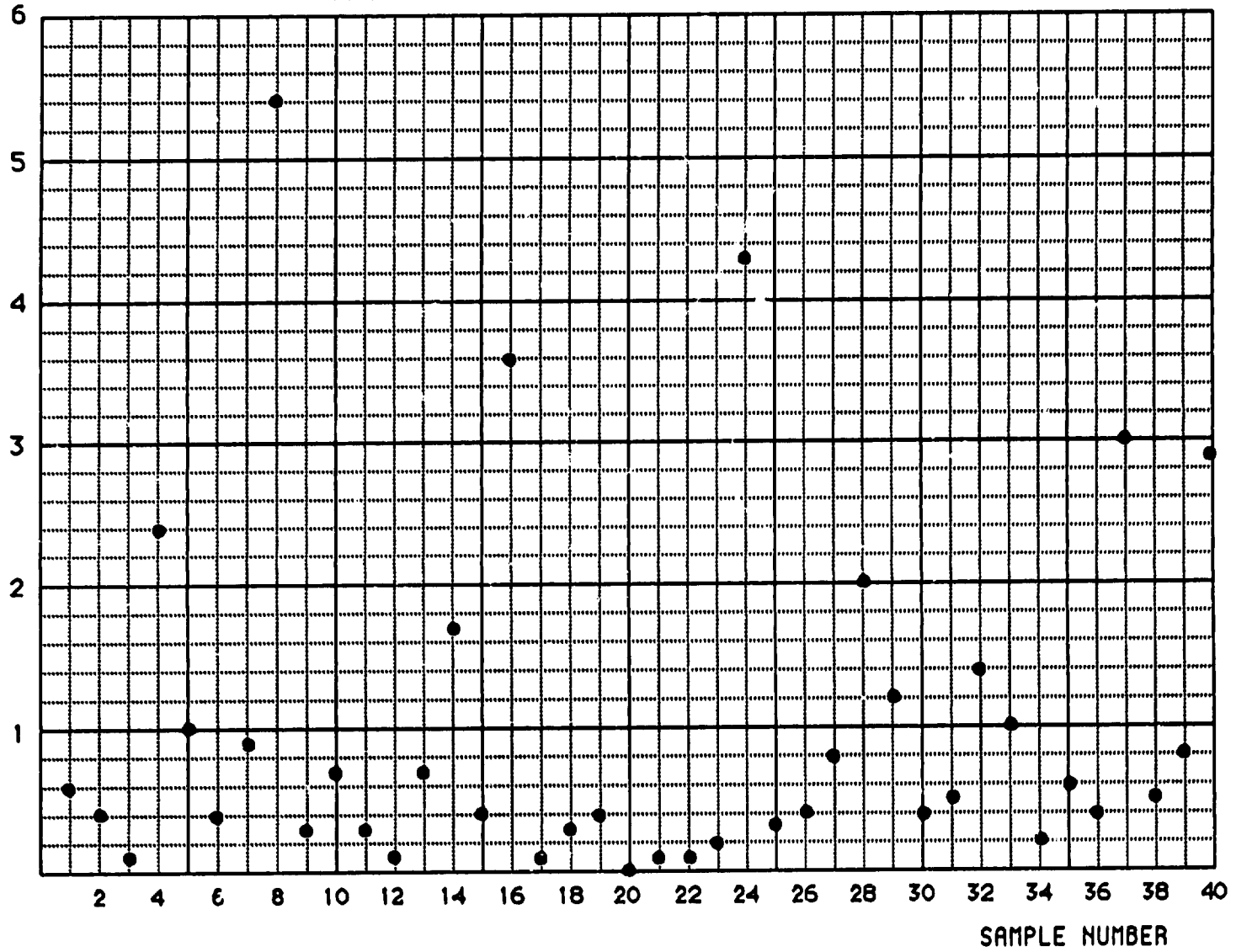
R Chart for Two Consecutive Containers
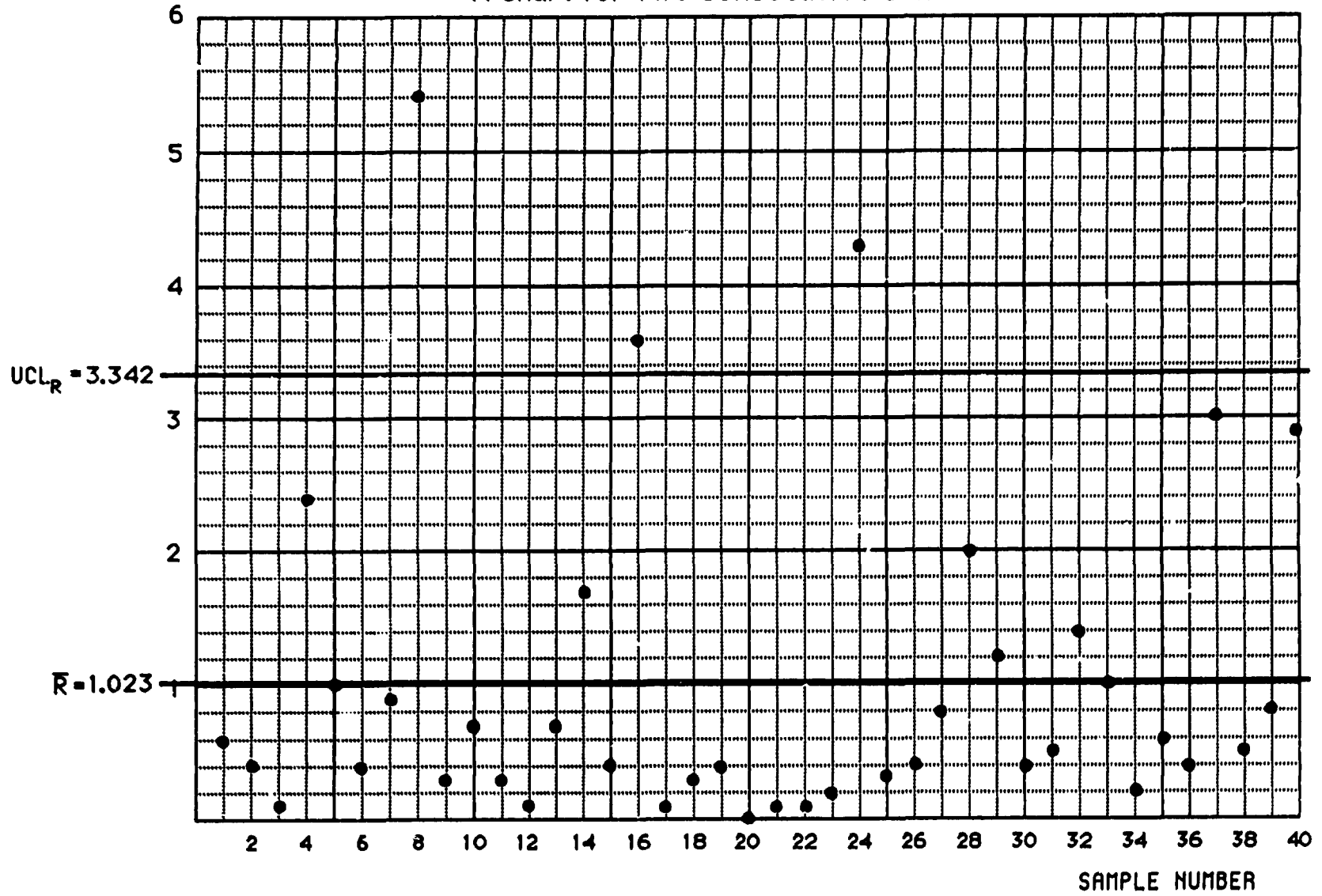
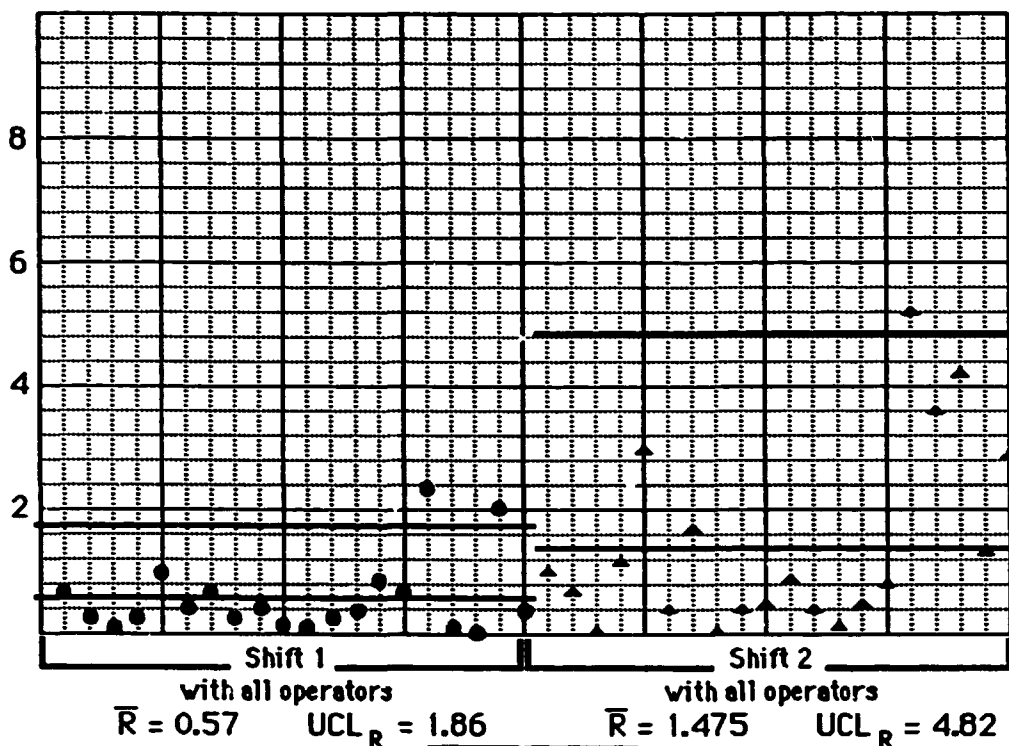Have the data been plotted in the most useful form?

What would you want?

Subgroup Ranges
Reorganized by Head and Shift

Note: Values of Range are recorded.

	Shift 1	Shift 2	
Head 1	0.6	1.0	
	0.3	0.7	
	0.1	0.1	
	0.3	1.2	
	1.0	3.0	
			$\bar{R} = 0.83$
Head 2	0.4	0.4	
	0.7	1.7	
	0.3	0.1	
	0.4	0.4	
	0.2	0.5	
			$\bar{R} = 0.51$
Head 3	0.1	0.9	
	0.3	0.4	
	0.4	0.2	
	0.8	0.5	
	0.6	0.8	
			$\bar{R} = 0.50$
Head 4	2.4	5.4	
	0.1	3.6	
	0.0	4.3	
	2.0	1.4	
	0.4	2.9	
			$\bar{R} = 2.25$
	$\bar{R} = 0.57$	$\bar{R} = 1.475$	

Note: <u>Strict time ordering destroyed</u>.

Ranges Plotted by Shift

R Chart

Shift 1 — with all operators
$\overline{R} = 0.57$ $UCL_R = 1.86$

Shift 2 — with all operators
$\overline{R} = 1.475$ $UCL_R = 4.82$

```
● Shift 1
▲ Shift 2
```

Ranges Plotted by Head

R Chart

Hd. 1	Hd. 2	Hd. 3	Hd. 4
$\overline{R} = 0.83$	$\overline{R} = 0.51$	$\overline{R} = 0.50$	$\overline{R} = 2.25$
$UCL_R = 2.71$	$UCL_R = 1.67$	$UCL_R = 1.63$	$UCL_R = 7.35$
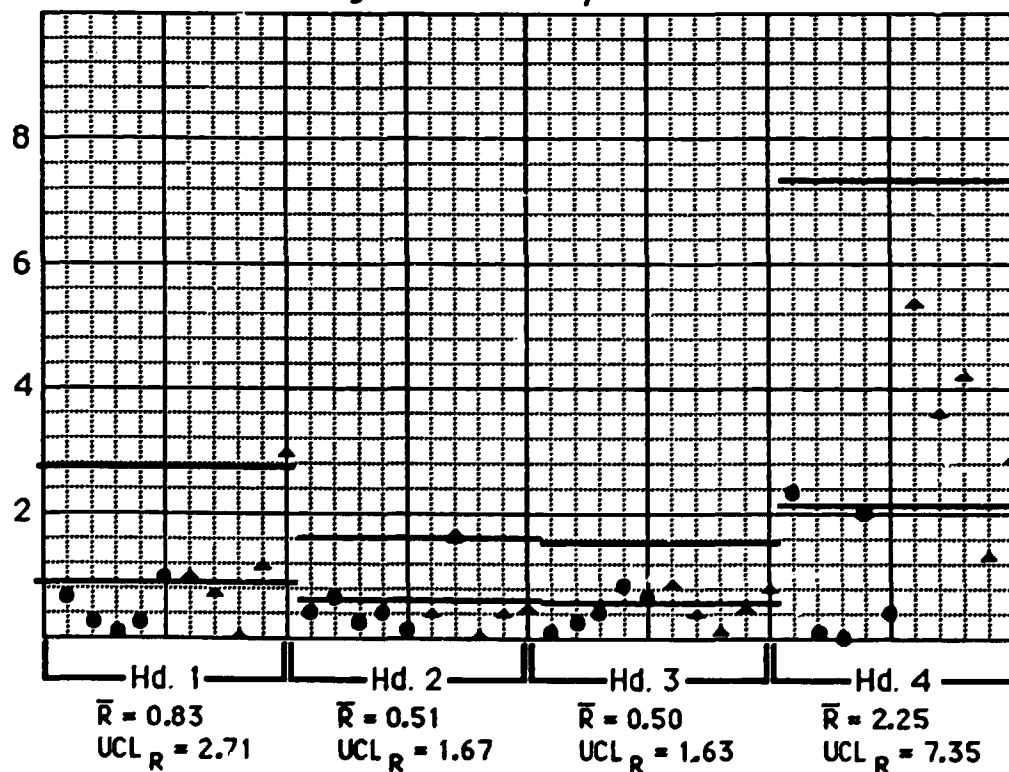
Note to Instructor:

Within head variations are not the same for all heads.

Head 4 has a larger variation for both shifts than do the other heads.

Shift two apparently has more variation than does shift one.

Actions taken (both must be reported to the group):
Head 4 overhauled.

Investigation revealed that shift two personnel followed a different procedure in routing bins of material to the filling machine and more short-term variation in density was observed.

Ask: Do these represent special causes?

Ask: What management behavior might lead to one shift using different procedures from another? What might improve communication and move us to agreement in our procedures?

Ask: Why do we often see this kind of shift differential and "accept it"? What issues must we confront to remove the differential?

More Analysis on the Filling Machine

Maintenance completed work on Head 4 and mixing procedures were reviewed on both shifts and standardized. Additional data are reported on the next page. The new data are also plotted for your convenience.

Does it appear that the process has changed? In what respect? How do you decide?

Is the process in control?

Instructor:

The decision as to "... has the process changed?" is awkward
to answer.

Because it was not previously in control, it is awkward to
judge the change. However, the within head variation is now
better understood and it appears to be smaller, by a goodly
amount, than the $\overline{R}$ = 1.023 reported earlier.

But yes, within head variaiton is now stable and that is a
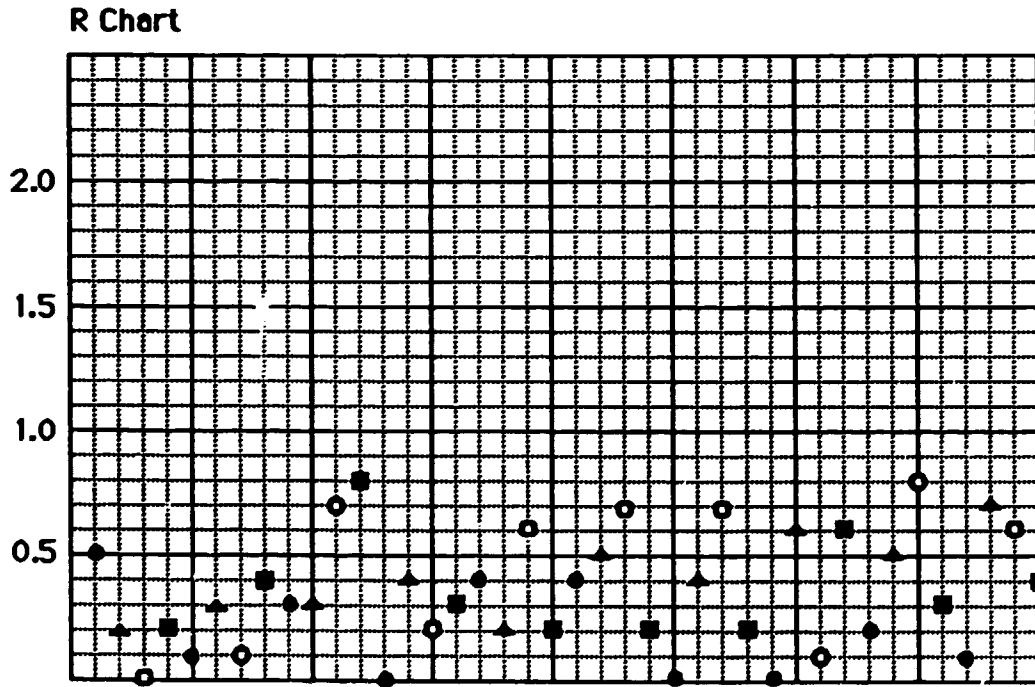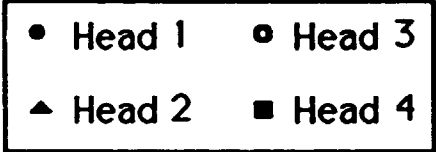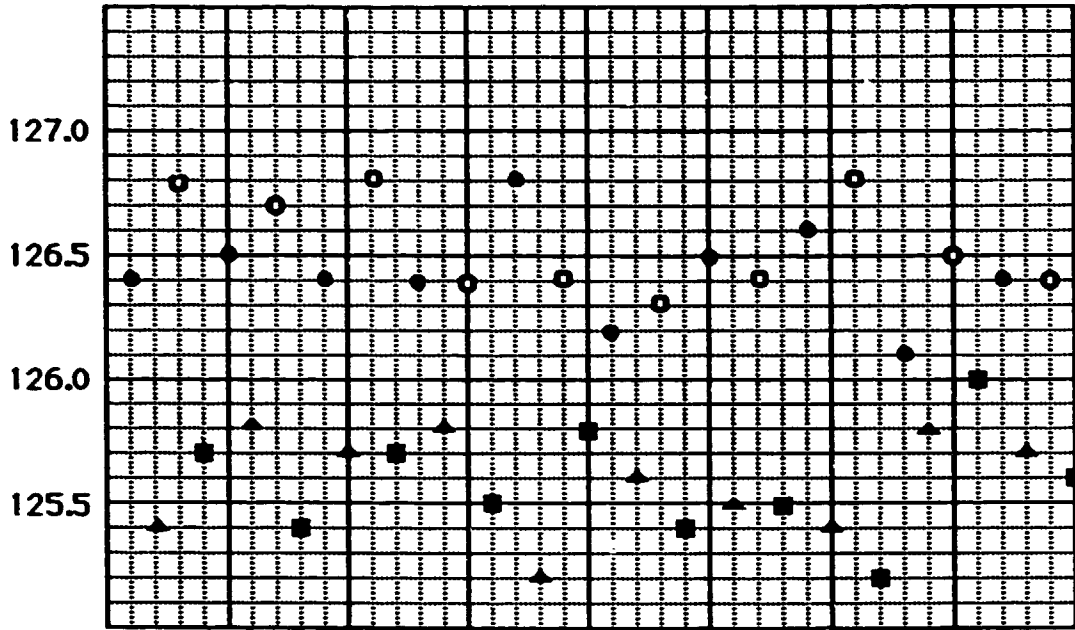positive change.

New $\overline{R}$ = 0.355
New UCL_R = 1.160

Means and Ranges of Subgroups
of Two Consecutive Containers from the Same Head

Shift	Head	$\overline{X}$	R	Shift	Head	$\overline{X}$	R
1	1	126.4	0.5	6	1	126.2	0.4
1	2	125.4	0.2	6	2	125.6	0.5
1	3	126.8	0.0	6	3	126.3	0.7
1	4	125.7	0.2	6	4	125.4	0.2
2	1	126.5	0.1	7	1	126.5	0.0
2	2	125.8	0.3	7	2	125.5	0.4
2	3	126.7	0.1	7	3	126.4	0.7
2	4	125.4	0.4	7	4	125.5	0.2
3	1	126.4	0.3	8	1	126.6	0.0
3	2	125.7	0.3	8	2	125.4	0.6
3	3	126.8	0.7	8	3	126.8	0.1
3	4	125.7	0.8	8	4	125.2	0.6
4	1	126.4	0.0	9	1	126.1	0.2
4	2	125.8	0.4	9	2	125.8	0.5
4	3	126.4	0.2	9	3	126.5	0.8
4	4	125.5	0.3	9	4	126.0	0.3
5	1	126.8	0.4	10	1	126.4	0.1
5	2	125.2	0.2	10	2	125.7	0.7
5	3	126.4	0.6	10	3	126.4	0.6
5	4	125.8	0.2	10	4	125.6	0.4

$$\overline{R} = .355$$

$$\overline{\overline{X}} = 126.04$$

Means and Ranges of Subgroups of Two Consecutive Containers from the Same Head

X̄ Chart

● Head 1	○ Head 3
▲ Head 2	■ Head 4

R Chart

Means and Ranges of Subgroups of Two Consecutive Containers from the Same Head

$\bar{X}$ Chart

UCL$_{\bar{X}}$ = 126.71

127.0

126.5

$\bar{\bar{X}}$ = 126.04

126.0

125.5

LCL$_{\bar{X}}$ = 125.37

| ● Head 1 | ○ Head 3 |
| ▲ Head 2 | ■ Head 4 |

R Chart

2.0

1.5

UCL$_R$ = 1.160

1.0

0.5

$\bar{R}$ = .355
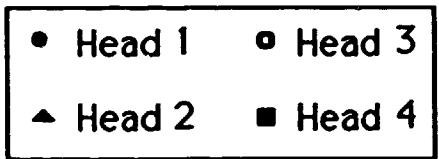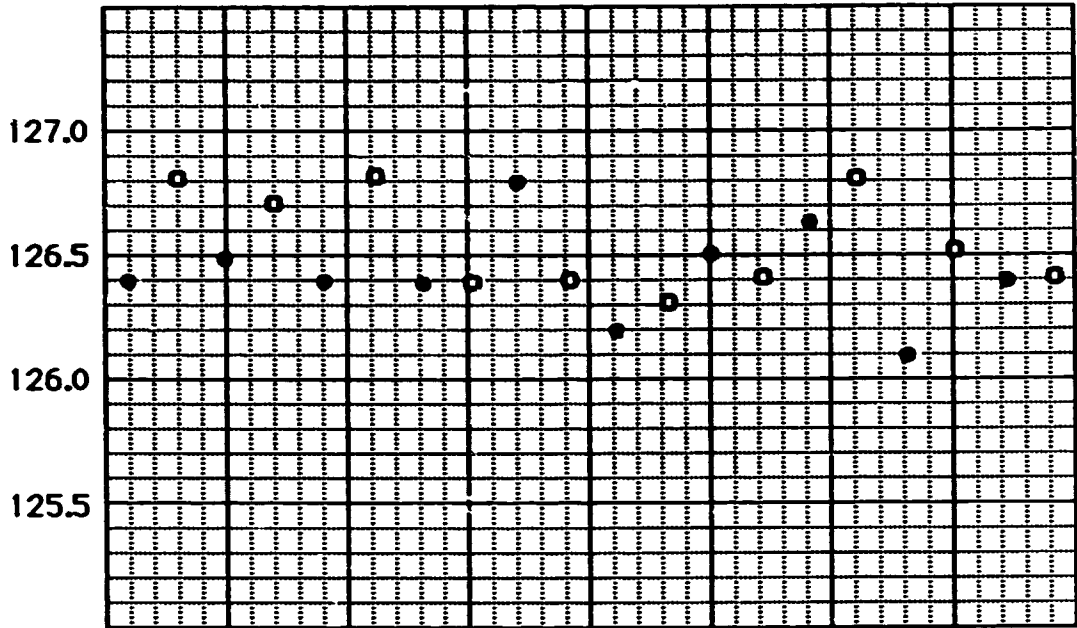
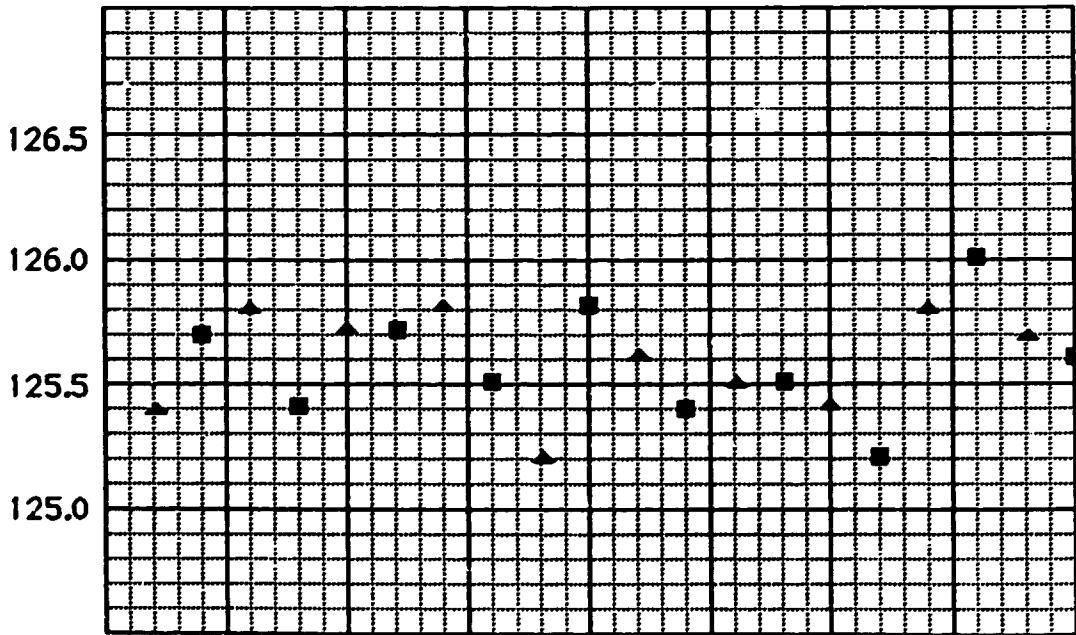© 1990, The University of Tennessee
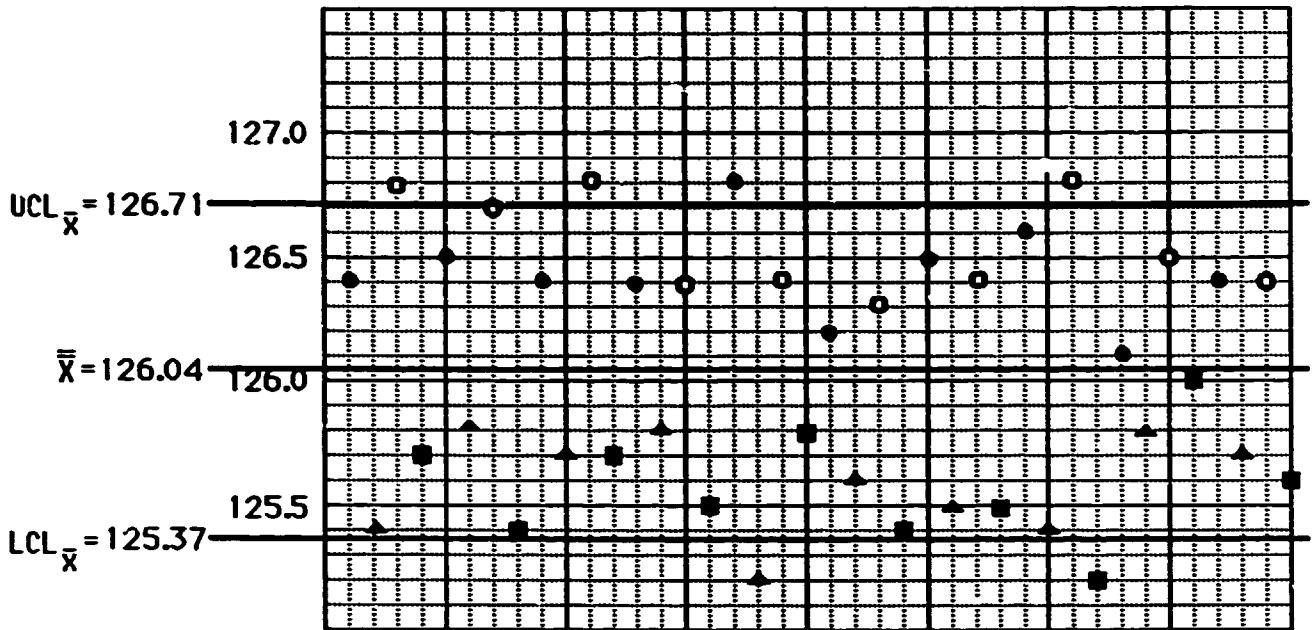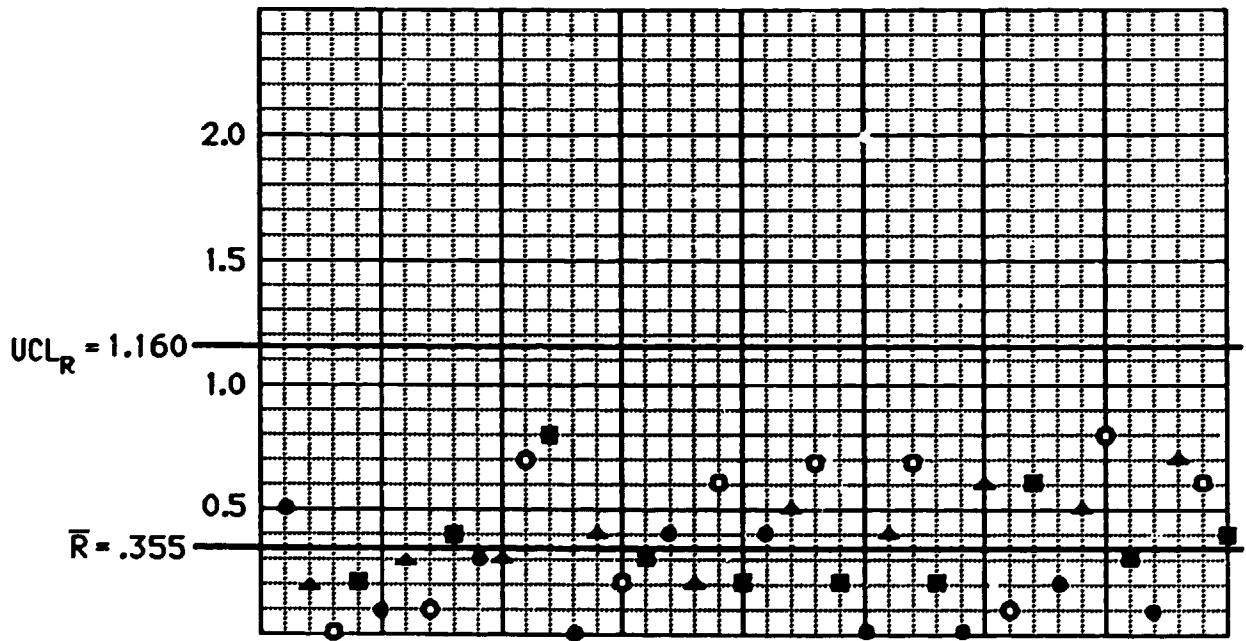
Instructor:

Since R chart shows no lack of consistency head-to-head, $\overline{R} = .355$ is used to construct $\overline{X}$ limits for all heads. Participants may choose to go back and compute $\overline{R}$ values for each head separately.
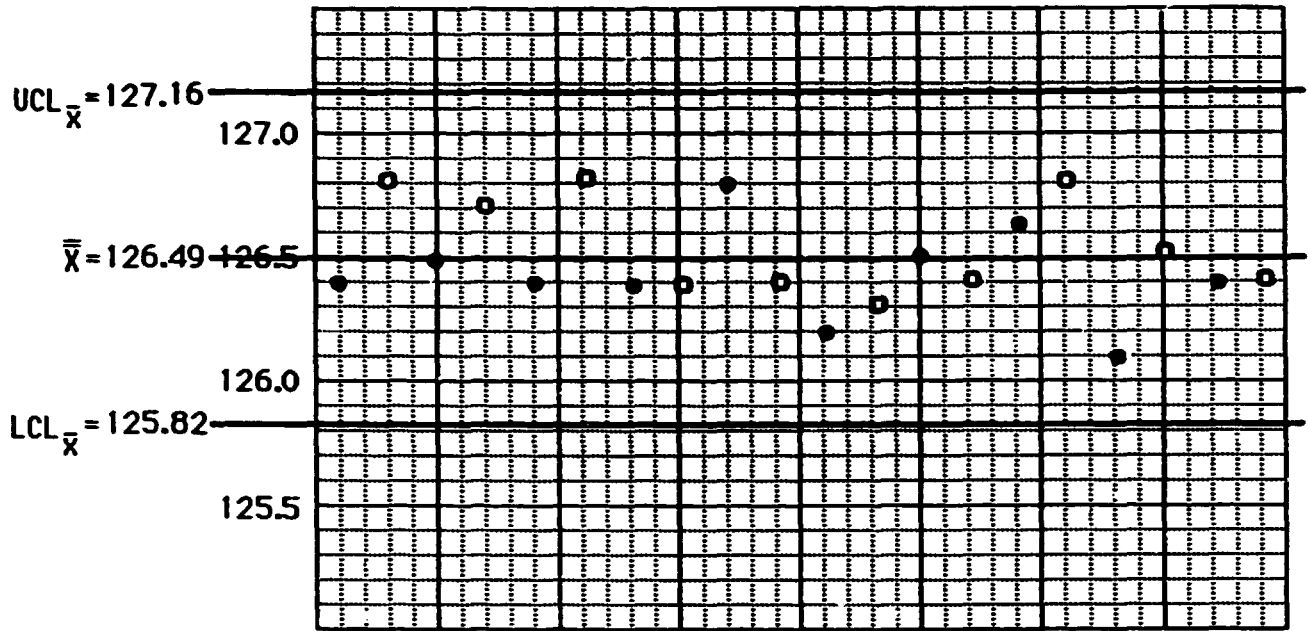
Means and Ranges of Subgroups of Two Consecutive
Containers from the Same Head

$\bar{X}$ Chart

• Head 1	◦ Head 3	
▲ Head 2	■ Head 4	

$\bar{X}$ Chart

Means and Ranges of Subgroups of Two Consecutive
X̄ Chart Containers from the Same Head

$\bar{X}$ Chart

UCL$_{\bar{X}}$ = 127.16

127.0

$\bar{\bar{X}}$ = 126.49   126.5

126.0

LCL$_{\bar{X}}$ = 125.82

125.5

| • Head 1 | ○ Head 3 |
| ▲ Head 2 | ■ Head 4 |

$\bar{X}$ Chart

126.5

UCL$_{\bar{X}}$ = 126.26

126.0

$\bar{\bar{X}}$ = 125.59   125.5

125.0

LCL$_{\bar{X}}$ = 124.92
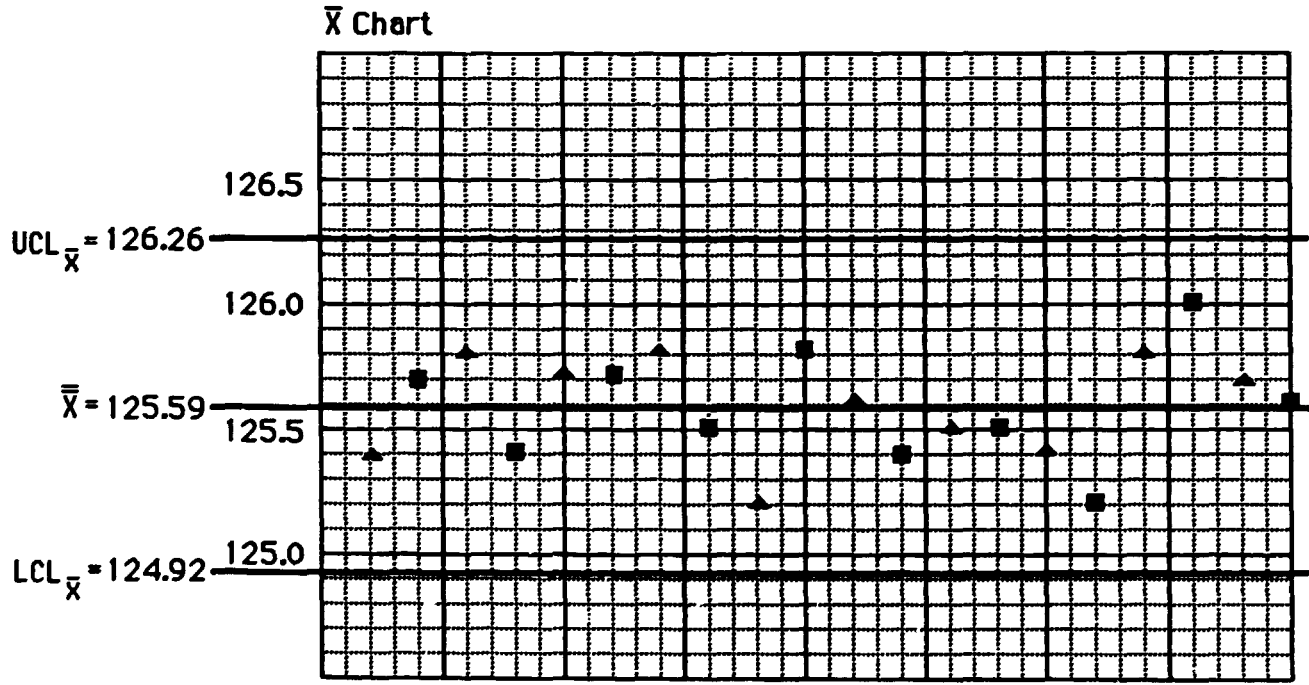
Note to Instructor:

Heads 1 and 3 are at the same averages and appear to be consistent. Heads 2 and 4 are also consistent, but at a lower average.

Note that for R-bar $\div d_2 = .315$, $125.59 - 3(.315) = 124.645$ (lower specification limit is 123.5).
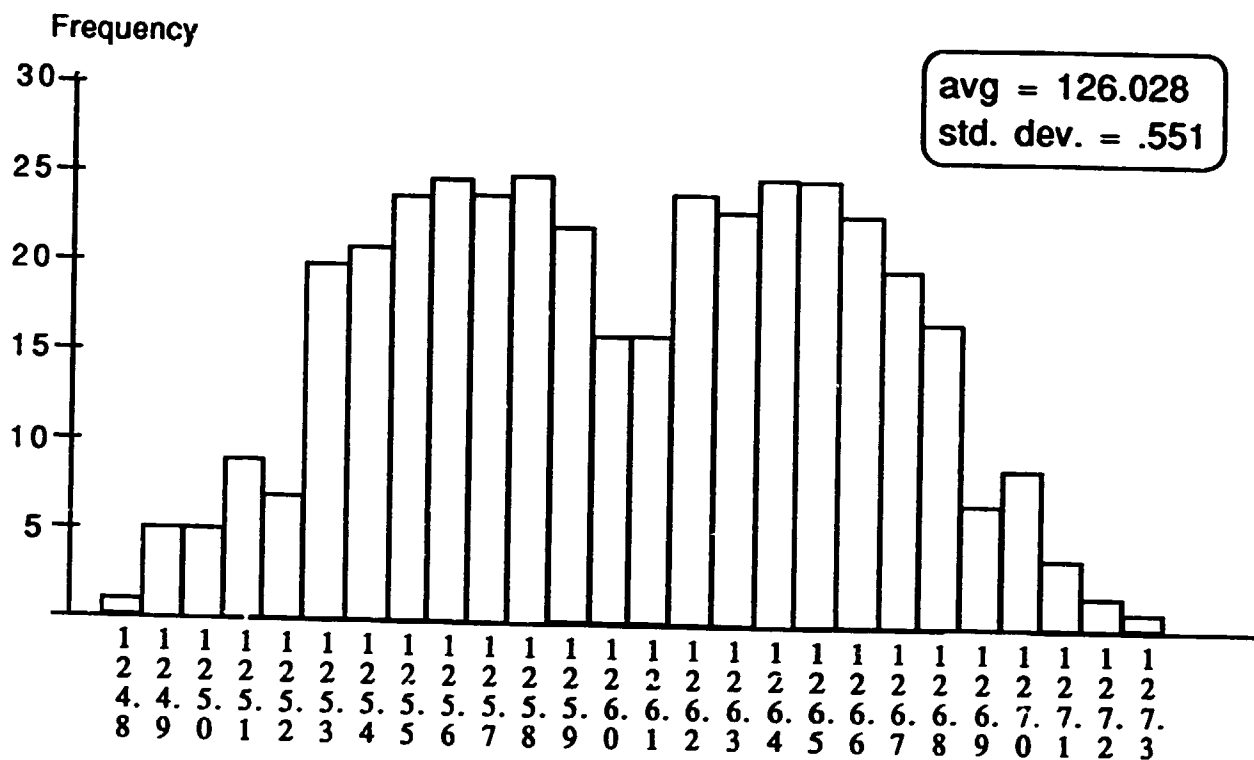
The within head variation, $6(.315) = 1.89 < 2.5$; there seems to be some room for between head variation.

Other data are collected and charted. Results
remain consistent over time. Histograms are
constructed and reported for your evaluation.

Up to this time, what has been the primary effect of
the work to stabilize and reduce within head
variation?

What will have to be done to take advantage of the
reduced variability?

Heads 1 and 3

Frequency

avg = 126.5
std. dev. = .315

Heads 2 and 4

Frequency

avg = 125.6
std. dev. = .315

Heads 1, 2, 3 and 4

Frequency

avg = 126.028
std. dev. = .551

Question:

If we can move the averages together, where should we move them?

THE BRAZIL PROGRAM
DETAILED OUTLINE FOR FIRST DAY

I THE FRAMEWORK AND RATIONALE

THERE IS A LOT OF TALK ABOUT QUALITY AND PRODUCTIVITY. WHY?

WHAT IS DRIVING THESE CONCERNS?

THE NATURE OF THE COMPETITION AND WHAT IT REQUIRES.

RATIONALIZING CONTINUOUS IMPROVEMENT.

CONTINUOUS IMPROVEMENT IN PRODUCTS AND/OR SERVICES CONSUMER
POWER: BETTER AND CHEAPER====> VALUE THE CONSUMER/USER
                                PERSPECTIVE: BREAD STORY/THE
                                PILGRIMS STORY

THE NEW ROLE/RESPONSIBILITY OF MANAGERIAL LEADERS

THE STRATEGIC IMPERATIVE=> THE CONTINUOUS CREATION OF VALUE
                           FOR THE USER OF PRODUCTS/SERVICES!

THE BASIC OBJECTIVE OF AN   =====> TO BE PURSUED FOR SERVICES
ORGANIZATION SEEKING GREATNESS   AND/OR PRODUCTS BASED UPON
                                    THE REAL OR PERCEIVED.
                                    EXTRAORDINARY VALUE!

II   ORGANIZATIONAL PURPOSE, CONTEXT, CUSTOMERS, AND CONTENT

OPERATIONAL DEFINITION OF A GREAT MANUFACTURING FIRM IN THE
YEAR 2000.

WHAT MIGHT BE SOUGHT FROM A GREAT MANUFACTURING FIRM IN THE
YEAR 2000?

WHAT WILL BE DIFFERENT FROM WHAT IS PRESENTLY REQUIRED?

WHAT CHANGES WILL BE REQUIRED IN THE CURRENT CONCEPT AND
EXECUTION OF A MANUFACTURING ORGANIZATION?

WHO ULTIMATELY DETERMINES WHETHER AN ORGANIZATION IS GREAT?

WHO ARE THE CUSTOMERS?

WHAT DO THEY EXPECT? WHAT DO THEY VALUE?

WHAT ARE THE PRODUCTS/SERVICES?

WHAT ARE THE SYSTEMS THAT PRODUCE THE PRODUCTS/SERVICES?

CAN SUCH SYSTEMS BE MANAGED AND IMPROVED UPON?

III ORGANIZATIONAL SYSTEMS

WHAT ARE THE CROSS-FUNCTIONAL SYSTEMS OF THE MANUFACTURING
FIRM?

WHICH ARE THE FUNDAMENTALLY CRITICAL SYSTEMS OF THE FIRM?

IV MANAGING THE CONTINUOUS IMPROVEMENT OF SYSTEMS

WHAT IS INVOLVED IN THE DESCRIPTION OF AN ORGANIZATIONAL
SYSTEM?

WHAT IS MEANT BY MEASUREMENT, ASSESSMENT, STANDARDIZATION,
AND CONSTRUCTIVE CONTINUOUS IMPROVEMENT?

WHAT IS THE SIGNIFICANCE OF MEASURING IMPROVEMENT OF MEANS
VERSUS THE MONITORING OF THE IMPROVEMENT OF ENDS?

THE NEW ROLE OF MANAGERIAL LEADERSHIP AS RELATES TO
CONTINUOUS IMPROVEMENT IN THE PRODUCTION OF VALUE.

ORGANIZATIONAL CULTURAL AND DESIGN CONSIDERATIONS

V WHAT HAVE WE LEARNED?

WHAT DO WE UNDERSTAND THE METHOD TO BE?
HOW MIGHT IT BE APPLIED?
WHAT WOULD BE THE MERITS OF SUCH AN APPROACH?

VI THE FUTURE

THE CENTER FOR ORGANIZATIONAL EFFECTIVENESS: WHAT IS IT AND
WHAT MIGHT IT MEAN?

OBJECTIVE

THROUGH THE USE OF A GUIDED EXPERIENTIAL
LEARNING PROCESS TO UNDERSTAND:

- WHAT THE METHODOLOGY OF THE MANAGEMENT
  DEVELOPMENT CENTER IS AND INVOLVES.

- HOW THE METHOD, APPROACH AND SUBJECT
  MATTER CAN BE APPLIED TO A MANUFACTURING
  ORGANIZATION WHICH IS SEEKING GREATNESS.