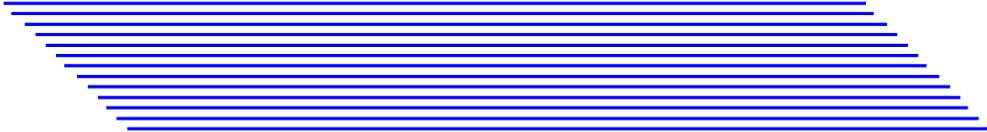


12 DAYS TO DEMING



WORKBOOK



HENRY R. NEAVE

B1

WORKBOOK

DAYS 1–3

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DAY 1: THE “OVERTURE” and THE DEMING STORY

Pause for Thought 1-a comes from Day 1 page 20.

The red box indicates there will now be a Pause for Thought or Activity which is immediately followed by some relevant commentary. My commentary will be in the subsequent shaded red box. So always try to avoid looking inside the shaded box—just a single sentence in this case—while you’re thinking about what the “request for action” is asking you to do. Preferably cover it up with something!

PAUSE FOR THOUGHT 1-a

“Quality is made at the top.” Do you agree, and why?

The quality of what a company provides for its customers, product and/or service, results from how the top management runs the company—and how the company is run depends on top management’s values, principles, priorities and knowledge.

Return (very briefly) to the top of Day 1 page 21.

Both of these Pauses for Thought come from Day 1 page 21.

Unlike a red box, a green box indicates an Activity or Pause for Thought with no following box of commentary.

PAUSE FOR THOUGHT 1–b

Why do you think Dr Deming said that, if you manage by results, both quality and morale go down?

(If you cannot think of reasons now, be sure that you will find plenty as the course progresses.)



PAUSE FOR THOUGHT 1–c

I well remember a time that I met up with an old acquaintance. I hadn't seen him for a while, so he didn't know of my change in career and interests (and university)—he thought I still lectured in Mathematical Statistics somewhere else. “So what Department are you in, here at this university?”, he asked. “The Quality Unit”, I said. His face dropped. “Quality? Ugh!”

Why do you think that the word “Quality” might have provoked such a negative reaction?

(For brief discussion see Appendix page 6.)



Continue at the top of Day 1 page 22.

Activity 1–d comes from Day 1 page 24.

Here is an example of a “request for action” that is exceedingly open-ended. You could content yourself by writing some notes on the first few thoughts that come into your mind. Or it could be the subject of a number of PhD theses! Since I’m calling this an “Activity” (not even a “Major Activity”!) I am indicating that my preference lies toward the former of those two extremes!

ACTIVITY 1–d

Considering the breadth indicated in the title of Dr Deming’s final book: *The New Economics for Industry, Government, Education*, it will be worthwhile for you to spend a little time thinking about the ways that the Government and Education systems in your country help or hinder Industry, and the quality of what it produces and provides. How might they be improved? And, again referring to that title, how might some “old” views of Economics also be a hindrance, and what might “New” views take into account?

In such an Activity you are not expected to be able to set the world to rights! Its purpose is to trigger some thoughts that might help you to make some useful connections as the course progresses.



(Continue to Pause for Thought 1–e overleaf.)

Pause for Thought 1-e comes from Day 1 page 25.

PAUSE FOR THOUGHT 1-e

This is today’s final Pause for Thought and it goes to the opposite extreme compared with the previous Activity. Here I’m just asking you to consider briefly something very simple in preparation for discussion tomorrow. No calculations, no deep thought—just quickly jot down a couple of opinions for future reference.

Suppose you are the manager of a telephone call centre. A performance-monitoring scheme is in operation. For each member of staff who is being checked in any particular week, 50 of her callers are phoned back and asked whether or not they were satisfied with how their enquiries had been dealt with. The average satisfaction rate is around 80%, i.e. on average 40 of the callers turn out to have been satisfied—or, looking on the negative side, on average 10 of the callers were dissatisfied.

At the end of each week you hold a “progress meeting” to comment on the results. Let’s look on the grim side to start with! How much worse than the average of 10 dissatisfied callers would the result need to be for you to feel justified in at least cautioning the member of staff concerned: “Watch it! Take more care! This isn’t good enough!”? Any result worse than average, i.e. 11 or more dissatisfied customers? Actually, it’s not unknown for a person to be criticised if she gets just the 10 dissatisfied customers: after all, using a not-uncommon phrase, that’s “only average”.

Please note that I am not indicating my approval of this or any other such scheme! To criticise people simply because, according to some set of results, they appear below average or even “only average” is, I suggest, a rather dubious judgment mechanism. After all, that means you’re bound to be criticising around half of them even if they are *all* performing brilliantly!

Naturally, we would not expect everyone to get *exactly* 10 dissatisfied callers and 40 satisfied callers every week (something to do with understanding variation!). Sometimes the result of the count will be better than average, sometimes worse. But *how much* better or worse would it be reasonable for us to expect “just by chance”?

So, to repeat the above question, how much worse than the average of 10 dissatisfied callers would the result need to be for you to feel justified in at least cautioning the member of staff concerned? 12 dissatisfied callers? 13 dissatisfied callers? 14? What performance level do you feel, as the manager, would warrant your attention? I am not asking for any logical argument here: just write down your “gut feel”.

..... dissatisfied callers.

On the bright side, how much better than the average of 10 dissatisfied callers would a result need to be for you to feel justified in congratulating the member of staff: “Well done! Nice work! Keep it up!”? 9 dissatisfied callers? 8 dissatisfied callers? 7 dissatisfied callers? Fewer?

..... dissatisfied callers.



Continue on Day 1 page 26.

Major Activity 1-f (pages 5-7) comes from Day 1 pages 42-44.

MAJOR ACTIVITY 1-f

To complete this opening day of the course, take a few minutes to imagine yourself in each of the following ten pairs of opposite environments. Then compare and write down some features describing how you would behave and perform in those contrasting situations.

- Your work is (a) greatly fulfilling and exciting, or it's (b) dull and demoralising.

(a)

(b)

- You (a) trust your colleagues at work, or (b) distrust them.

(a)

(b)

- You had (a) inadequate schooling, or (b) a brilliant education.

(a)

(b)



- You (a) had wonderful parents, or (b) suffered abuse of various kinds throughout your childhood.

(a)

(b)

- You (a) trust, or (b) distrust your spouse or other partner.

(a)

(b)

- You live in (a) a third-world country, or in (b) one of the rich nations.

(a)

(b)

- You're living at a time when your country is in a state of (a) peace, or (b) war.

(a)

(b)



- You are (a) rich or, at least, “comfortably off”, or (b) poverty-stricken.

(a)

(b)

- All around you are (a) back-biters and points-scorers, or (b) supporters and helpers.

(a)

(b)

- You’re in an environment of (a) conflict, competition, winners and losers; or (b) genuine mutual cooperation so that everybody gains.

(a)

(b)

(My brief summing-up is on Appendix page 6.)



←
(Stats-level 0 only)

DAY 2: THE EXPERIMENT ON RED BEADS

→
(Stats-levels 1–3)

Pause for Thought 2–a comes from Day 2 page 4.

PAUSE FOR THOUGHT 2–a

Even though these were not real sales figures, and this was not a real management team, do you think that this was a reasonable account of how management might have reacted had these been real sales data?

All I can say is that, in my experience, the answer is Yes! I might comment that the management are going to be awfully busy if they keep acting one way whenever a figure goes up, and another way whenever it goes down—for, except on the odd occasions when the figure stays the same, it *will* always either go up or go down! We'll return to this illustration tomorrow.

Continue on Day 2 page 5.

Pause for Thought 2–b comes from Day 2 page 7.

PAUSE FOR THOUGHT 2–b

As we grow older, and hopefully wiser, we may think about several things quite differently from the way that we used to. So identify something that you now regard very differently from the way that you did back in your younger days. *(If you are still very young then you might like to find an older friend to share some thoughts and experiences with you here.)*

Why did you originally think about it in the way that you did?

What made you change your mind?

Was the experience of changing your mind difficult—and painful?

(For my discussion see Appendix page 7.)

Return (very briefly) to the top of Day 2 page 8.

Pause for Thought 2-c comes from Day 2 page 8.

PAUSE FOR THOUGHT 2-c

What are some ways we can acquire and suffer from “illusion of knowledge”?

Should we be wary of them?

(For discussion, again see Appendix page 7.)



Continue on Day 2 page 9.

Pause for Thought 2-d (pages 12-13) comes from Day 2 pages 11-12.

PAUSE FOR THOUGHT 2-d

Take a careful look through these results. What main feature occurs to you when comparing the six Willing Workers with each other?

| | NAME | WEEK 1 | WEEK 2 | WEEK 3 | WEEK 4 | TOTAL SHEET 2 |
|----|----------------|--------|--------|--------|--------|---------------|
| 21 | ERULE | 7 | 11 | 3 | 6 | 6 |
| 28 | IGGY | 10 | 8 | 10 | 13 | 14 |
| 31 | RICHARD | 11 | 10 | 10 | | |
| 30 | MARTIN | 11 | 9 | 10 | 10 | 11 |
| 33 | ANDREW | 12 | 12 | 9 | | |
| 32 | PAT | 11 | 15 | 6 | | |
| | WEEKLY TOTAL | 62 | 65 | 48 | 60 | GRAND TOTAL |
| | TOTAL SO FAR | 62 | 127 | 175 | 235 | |
| | | ÷ 8 | ÷ 12 | ÷ 18 | ÷ 24 | |
| | AVERAGE SO FAR | 10.3 | 10.6 | 9.7 | 9.8 | |

INSPECTORS: BRENDA
 MARGARET MARY
 CHIEF INSPECTOR: JOE
 RECORDER: DEE

“ANALYSIS” OF THE RESULTS

The most obvious phenomenon is surely Ernie’s remarkably good performance compared with everybody else. His second week was rather disappointing (although that’s not difficult to explain—see Day 2 page 12). Otherwise, his superiority is plain for all to see. Ernie was the only person in single figures during the first week, when both he and everybody else was carrying out the work for the first time. And, as soon as the forthcoming performance appraisal scheme was announced (just before the beginning of Week 3), he turned out the quite exceptional result of only three defectives—half as many as were obtained anywhere else in the whole experiment. Subsequently, during *both* halves of his two-shift working in Week 4, he produced just six defectives, while Iggi and Martin (the other two workers who had managed to hold on to their jobs after their appraisals) were into double figures each time.

Continue after the above commentary on Day 2 page 12.

Pause for Thought 2–e comes from Day 2 page 16.

PAUSE FOR THOUGHT 2–e

What does the control chart on Day 2 page 15 tell you?

(For brief but very important discussion, see Appendix page 7 one more time.)

Continue at the concluding comment on Day 2 page 16.

Refer to Technical Aid 1 on Day 2 page 20.

Continue at Technical Aid 2 on Day 2 page 21.

Activity 2-f (pages 14–19) comes from Day 2 pages 22–27.

ACTIVITY 2-f

The next four pages show you, one at a time, the results from the Red Beads Experiment illustrated in *DemDim* Chapter 6.

There is space for you to insert indications of your reaction to the number of red beads obtained at each stage. Naturally, you could say even more if the experiment were “live”: you could see things to congratulate or criticise about the way the Willing Workers are carrying out their task (wrong angle, or too fast, or too slow, or too unsteady ...). But there’s still plenty that can be said in response to the figures alone!

To get you started, I have included my suggestions of reactions to the first four figures—they are very much the kind of comments that you might have heard from Dr Deming himself. See how you get on with the rest of the experiment. If, after some thought, you need extra help then I’ve given a few further suggestions on page 19.

NB The version of the experiment in *DemDim* Chapter 6 is Dr Deming’s. I should therefore mention three minor differences between his version here and my version which is otherwise being illustrated today:

- Dr Deming referred to the time period for each set of results as a day rather than a week.
- Although he would carry out a performance appraisal and fire the three workers who had produced most red beads, he did this after the fourth day rather than the third.
- For consistency with my own version of the experiment (which produces 24 items of data in all) I have not included the final week’s data here (nor in *DemDim*) which were obtained by the three “best” workers: Ed, Al and Audrey.

DAY 1

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-------|-------|-------|-------|--------|
| Audrey | 16 | | | | |
| John | | | | | |
| Al | | | | | |
| Carol | | | | | |
| Ben | | | | | |
| Ed | | | | | |
| Daily Totals | | | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-------|-------|-------|-------|--------|
| Audrey | 16 | | | | |
| John | 9 | | | | |
| Al | | | | | |
| Carol | | | | | |
| Ben | | | | | |
| Ed | | | | | |
| Daily Totals | | | | | |

"What a terrible start! But you've only just been trained—weren't you watching?"

"That's better."

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-------|-------|-------|-------|--------|
| Audrey | 16 | | | | |
| John | 9 | | | | |
| Al | 4 | | | | |
| Carol | | | | | |
| Ben | | | | | |
| Ed | | | | | |
| Daily Totals | | | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-------|-------|-------|-------|--------|
| Audrey | 16 | | | | |
| John | 9 | | | | |
| Al | 4 | | | | |
| Carol | 7 | | | | |
| Ben | | | | | |
| Ed | | | | | |
| Daily Totals | | | | | |

"Excellent: continuous improvement."

"What a disappointment."

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-------|-------|-------|-------|--------|
| Audrey | 16 | | | | |
| John | 9 | | | | |
| Al | 4 | | | | |
| Carol | 7 | | | | |
| Ben | 9 | | | | |
| Ed | | | | | |
| Daily Totals | | | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-------|-------|-------|-------|--------|
| Audrey | 16 | | | | |
| John | 9 | | | | |
| Al | 4 | | | | |
| Carol | 7 | | | | |
| Ben | 9 | | | | |
| Ed | 9 | | | | |
| Daily Totals | 54 | | | | |



DAY 2

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-------|-------|-------|--------|
| Audrey | 16 | 10 | | | |
| John | 9 | | | | |
| Al | 4 | | | | |
| Carol | 7 | | | | |
| Ben | 9 | | | | |
| Ed | 9 | | | | |
| Daily Totals | 54 | | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-------|-------|-------|--------|
| Audrey | 16 | 10 | | | |
| John | 9 | 11 | | | |
| Al | 4 | | | | |
| Carol | 7 | | | | |
| Ben | 9 | | | | |
| Ed | 9 | | | | |
| Daily Totals | 54 | | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-------|-------|-------|--------|
| Audrey | 16 | 10 | | | |
| John | 9 | 11 | | | |
| Al | 4 | 9 | | | |
| Carol | 7 | | | | |
| Ben | 9 | | | | |
| Ed | 9 | | | | |
| Daily Totals | 54 | | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-------|-------|-------|--------|
| Audrey | 16 | 10 | | | |
| John | 9 | 11 | | | |
| Al | 4 | 9 | | | |
| Carol | 7 | 11 | | | |
| Ben | 9 | | | | |
| Ed | 9 | | | | |
| Daily Totals | 54 | | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-------|-------|-------|--------|
| Audrey | 16 | 10 | | | |
| John | 9 | 11 | | | |
| Al | 4 | 9 | | | |
| Carol | 7 | 11 | | | |
| Ben | 9 | 17 | | | |
| Ed | 9 | | | | |
| Daily Totals | 54 | | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-------|-------|--------|
| Audrey | 16 | 10 | | | |
| John | 9 | 11 | | | |
| Al | 4 | 9 | | | |
| Carol | 7 | 11 | | | |
| Ben | 9 | 17 | | | |
| Ed | 9 | 7 | | | |
| Daily Totals | 54 | 65 | | | |

DAY 3

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-------|-------|--------|
| Audrey | 16 | 10 | 7 | | |
| John | 9 | 11 | | | |
| Al | 4 | 9 | | | |
| Carol | 7 | 11 | | | |
| Ben | 9 | 17 | | | |
| Ed | 9 | 7 | | | |
| Daily Totals | 54 | 65 | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-------|-------|--------|
| Audrey | 16 | 10 | 7 | | |
| John | 9 | 11 | 12 | | |
| Al | 4 | 9 | | | |
| Carol | 7 | 11 | | | |
| Ben | 9 | 17 | | | |
| Ed | 9 | 7 | | | |
| Daily Totals | 54 | 65 | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-------|-------|--------|
| Audrey | 16 | 10 | 7 | | |
| John | 9 | 11 | 12 | | |
| Al | 4 | 9 | 13 | | |
| Carol | 7 | 11 | | | |
| Ben | 9 | 17 | | | |
| Ed | 9 | 7 | | | |
| Daily Totals | 54 | 65 | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-------|-------|--------|
| Audrey | 16 | 10 | 7 | | |
| John | 9 | 11 | 12 | | |
| Al | 4 | 9 | 13 | | |
| Carol | 7 | 11 | 14 | | |
| Ben | 9 | 17 | | | |
| Ed | 9 | 7 | | | |
| Daily Totals | 54 | 65 | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-------|-------|--------|
| Audrey | 16 | 10 | 7 | | |
| John | 9 | 11 | 12 | | |
| Al | 4 | 9 | 13 | | |
| Carol | 7 | 11 | 14 | | |
| Ben | 9 | 17 | 9 | | |
| Ed | 9 | 7 | | | |
| Daily Totals | 54 | 65 | | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-----------|-------|--------|
| Audrey | 16 | 10 | 7 | | |
| John | 9 | 11 | 12 | | |
| Al | 4 | 9 | 13 | | |
| Carol | 7 | 11 | 14 | | |
| Ben | 9 | 17 | 9 | | |
| Ed | 9 | 7 | 12 | | |
| Daily Totals | 54 | 65 | 67 | | |



DAY 4

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-----------|-------|--------|
| Audrey | 16 | 10 | 7 | 6 | 39 |
| John | 9 | 11 | 12 | | |
| Al | 4 | 9 | 13 | | |
| Carol | 7 | 11 | 14 | | |
| Ben | 9 | 17 | 9 | | |
| Ed | 9 | 7 | 12 | | |
| Daily Totals | 54 | 65 | 67 | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-----------|-------|--------|
| Audrey | 16 | 10 | 7 | 6 | 39 |
| John | 9 | 11 | 12 | 10 | 42 |
| Al | 4 | 9 | 13 | | |
| Carol | 7 | 11 | 14 | | |
| Ben | 9 | 17 | 9 | | |
| Ed | 9 | 7 | 12 | | |
| Daily Totals | 54 | 65 | 67 | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-----------|-------|--------|
| Audrey | 16 | 10 | 7 | 6 | 39 |
| John | 9 | 11 | 12 | 10 | 42 |
| Al | 4 | 9 | 13 | 11 | 37 |
| Carol | 7 | 11 | 14 | | |
| Ben | 9 | 17 | 9 | | |
| Ed | 9 | 7 | 12 | | |
| Daily Totals | 54 | 65 | 67 | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-----------|-------|--------|
| Audrey | 16 | 10 | 7 | 6 | 39 |
| John | 9 | 11 | 12 | 10 | 42 |
| Al | 4 | 9 | 13 | 11 | 37 |
| Carol | 7 | 11 | 14 | 11 | 43 |
| Ben | 9 | 17 | 9 | | |
| Ed | 9 | 7 | 12 | | |
| Daily Totals | 54 | 65 | 67 | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-----------|-------|--------|
| Audrey | 16 | 10 | 7 | 6 | 39 |
| John | 9 | 11 | 12 | 10 | 42 |
| Al | 4 | 9 | 13 | 11 | 37 |
| Carol | 7 | 11 | 14 | 11 | 43 |
| Ben | 9 | 17 | 9 | 13 | 48 |
| Ed | 9 | 7 | 12 | | |
| Daily Totals | 54 | 65 | 67 | | |

| | Day 1 | Day 2 | Day 3 | Day 4 | Totals |
|---------------------|-----------|-----------|-----------|-----------|------------|
| Audrey | 16 | 10 | 7 | 6 | 39 |
| John | 9 | 11 | 12 | 10 | 42 |
| Al | 4 | 9 | 13 | 11 | 37 |
| Carol | 7 | 11 | 14 | 11 | 43 |
| Ben | 9 | 17 | 9 | 13 | 48 |
| Ed | 9 | 7 | 12 | 7 | 35 |
| Daily Totals | 54 | 65 | 67 | 58 | 244 |



Here are a few more suggestions:

- On Day 2 for Al: *"You were yesterday's top performer—must have let it go to your head."*
On Day 2 after Ben's 17: *"Hold it—stop the line!"*
At the end of Day 2: *"65? That's a lot worse than the first week! Quite dreadful."*
On Day 3 for Al: *"From bad to worse."*
On Day 3 for Ben: *"I'm glad you learned your lesson."*
On Day 4 for Audrey: *"You're a slow learner. But I'm proud of you."*
On Day 4 for John: *"Very consistent. Consistently bad."*

Now, if you haven't done so already, go back and try to complete your remarks for all the remaining results.

(Then, finally, take a look at my complete set of remarks on Appendix page 8.)

Continue following the above box on Day 2 page 27.

Activity 2-g (pages 20-25) comes from Day 2 pages 32-37.

ACTIVITY 2-g

As you will see, I have reproduced for you below and on the next page the statisticians' data week by week. There is space on the right of the data for your Foreman-like comments on every count of red beads. An advantage of your carrying out this Activity without an audience is that you can have a little time to consider each response rather than having to come up with it "off the top of your head". But don't take too long about it!

| NAME | WEEK 1 |
|-------------------|-----------|
| DAVID W. | 9 |
| DAVID R. | 6 |
| FRANK | 7 |
| REG | 8 |
| JOHN | 9 |
| NEIL | 11 |
| WEEKLY TOTAL | 50 |
| TOTAL SO FAR | 50 |
| | ÷6 |
| AVERAGE SO FAR | 8.3 |

(No good looking in the Appendix for more hints—I've given you plenty of help already!)

| NAME | WEEK 1 | WEEK 2 |
|-------------------|-----------|-----------|
| DAVID W. | 9 | 8 |
| DAVID R. | 6 | 8 |
| FRANK | 7 | 5 |
| REG | 8 | 4 |
| JOHN | 9 | 3 |
| NEIL | 11 | 13 |
| WEEKLY TOTAL | 50 | 41 |
| TOTAL SO FAR | 50 | 91 |
| | ÷6 | ÷12 |
| AVERAGE SO FAR | 8.3 | 7.6 |

| | WEEK 1 | WEEK 2 | WEEK 3 |
|-------------------|-----------|-----------|-----------|
| NAME | | | |
| DAVID W. | 9 | 8 | 10 |
| DAVID R. | 6 | 9 | 12 |
| FRANK | 7 | 5 | 10 |
| REG | 8 | 4 | 9 |
| JOHN | 9 | 3 | 8 |
| NEIL | 11 | 13 | 10 |
| WEEKLY TOTAL | 50 | 41 | 59 |
| TOTAL SO FAR | 50 | 91 | 150 |
| | ÷6 | ÷12 | ÷18 |
| AVERAGE SO FAR | 8.3 | 7.6 | 8.4 |

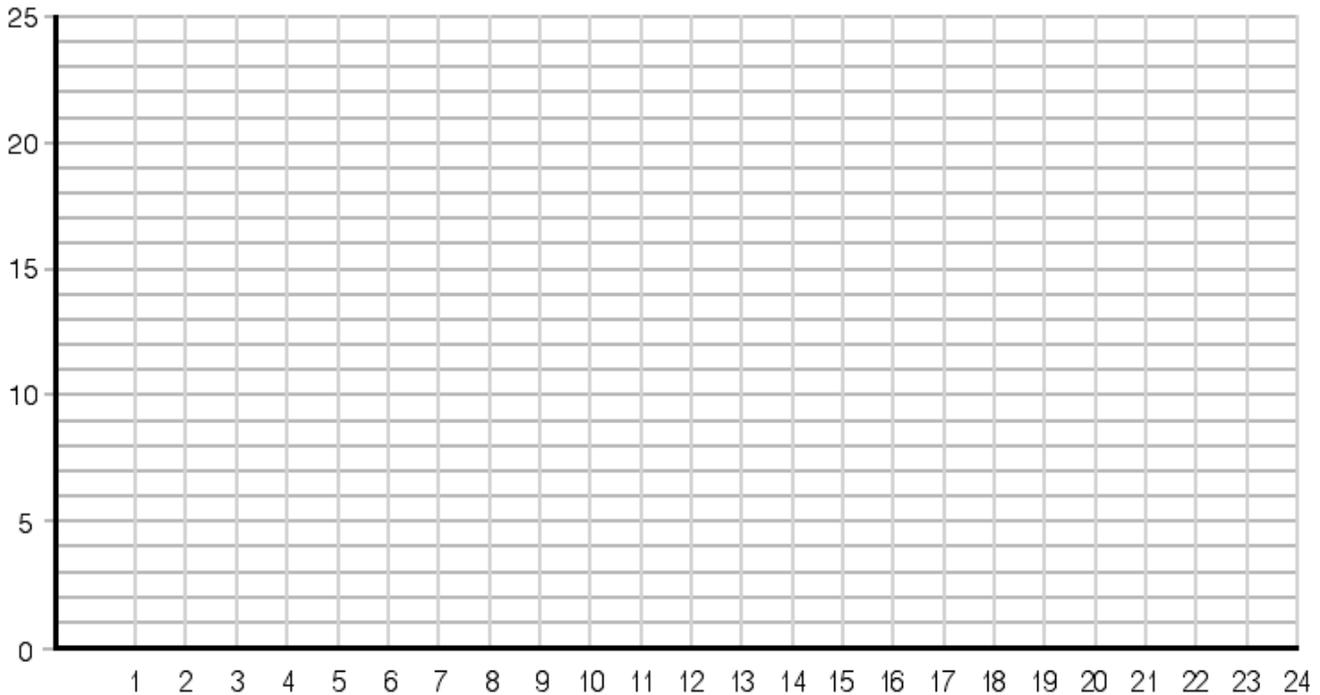
Again recall that, in my version of the experiment, I fired the three “worst” workers after the third week, leaving the other three to work double time in the fourth week. So, checking the table below, the “best” workers, Frank, Reg and John, produced 13, 7 and 8 red beads respectively during their first shift in the fourth week, followed in turn by 10, 7 and 8 in their second shift.

| | WEEK 1 | WEEK 2 | WEEK 3 | WEEK 4 |
|-------------------|-----------|-----------|-----------|-----------|
| NAME | | | | |
| DAVID W. | 9 | 8 | 10 | |
| DAVID R. | 6 | 9 | 12 | |
| FRANK | 7 | 5 | 10 | 13 10 |
| REG | 8 | 4 | 9 | 7 7 |
| JOHN | 9 | 3 | 8 | 8 8 |
| NEIL | 11 | 13 | 10 | |
| WEEKLY TOTAL | 50 | 41 | 59 | 53 |
| TOTAL SO FAR | 50 | 91 | 150 | 203 |
| | ÷6 | ÷12 | ÷18 | ÷24 |
| AVERAGE SO FAR | 8.3 | 7.6 | 8.4 | 8.5 |



Next, as I had to do when running the experiment for the statisticians, it's time for you to multi-task! You now take over as the Recorder and draw a run chart of the data. If you need reminding about how to draw a run chart, check back with the run chart of Dec's data on page 14. Also as on that page, so that you don't have to keep looking back, here are the statisticians' counts of red beads in time order:

9 6 7 8 9 11 8 8 5 4 3 13 10 12 10 9 8 10 13 7 8 10 7 8



Finally, insert the two control limits to turn the run chart into a control chart, and then state your conclusions. If you're on Stats-level 0 then simply look up the control limits on Appendix page 8. If you are on Stats-level 1 or higher then compute them in the space below. (If you need reminding about the details, Technical Aid 1 is on Day 2 page 20.)

(You can check your computations in Technical Aid 4 on Appendix page 9. But try it yourself first!)



Now it's time for you to resume the Foreman's role. Here are the Spaniards' rather different data. So please work through them as you did with the statisticians' data. (Remember that these are extracts from the *completed* version of Jose's table; thus ignore the fact that the names Ignacio, Orlando and Tamasa are crossed out since, of course, that did not happen until the end of the third week.)

| NOMBRE | SEMANA 1 |
|---------------------|----------|
| IGNACIO | 16 |
| ORLANDO | 9 |
| PACO | 9 |
| Franisco | 11 |
| Tamasa | 15 |
| Jesus | 11 |
| TOTAL SEMANAL | 71 |
| TOTAL A LA FECHA | 71 |
| | -8 |
| PREMEDIO A LA FECHA | 11.8 |

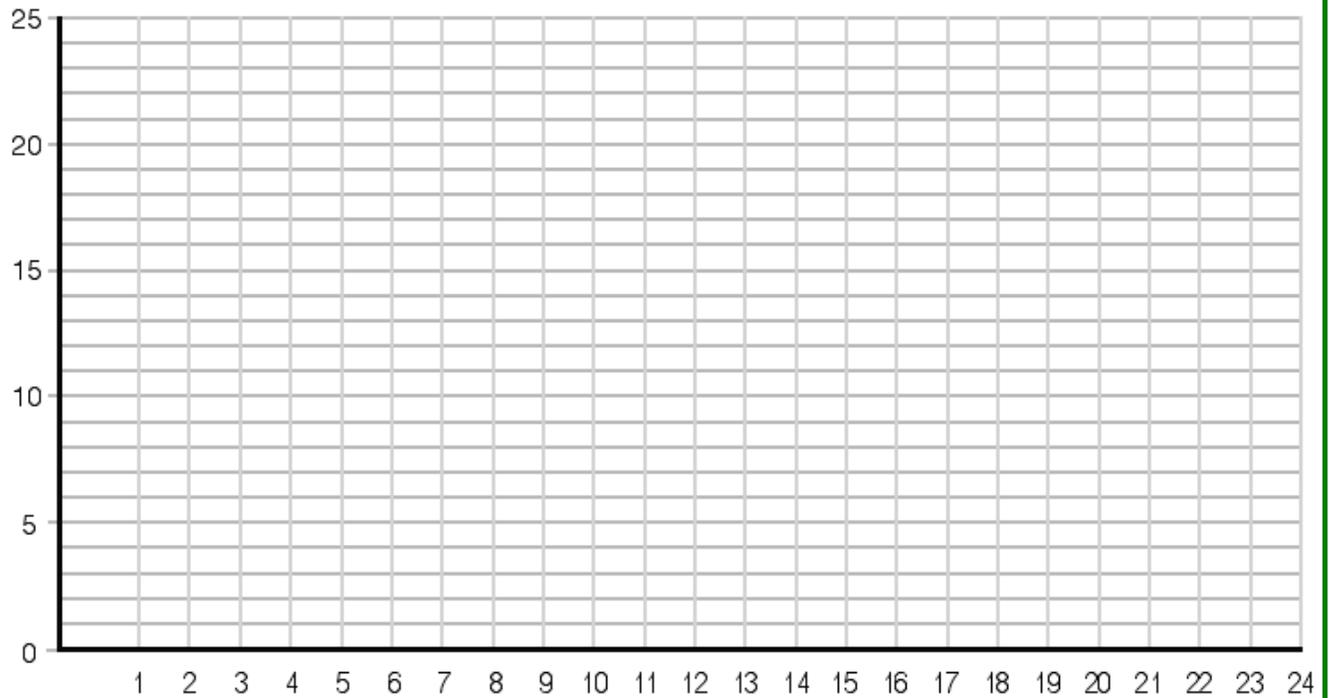
| NOMBRE | SEMANA 1 | SEMANA 2 |
|---------------------|----------|----------|
| IGNACIO | 16 | 10 |
| ORLANDO | 9 | 10 |
| PACO | 9 | 12 |
| Franisco | 11 | 12 |
| Tamasa | 15 | 9 |
| Jesus | 11 | 9 |
| TOTAL SEMANAL | 71 | 62 |
| TOTAL A LA FECHA | 71 | 133 |
| | -8 | +12 |
| PREMEDIO A LA FECHA | 11.8 | 11.08 |

| NOMBRE | SEMANA 1 | SEMANA 2 | SEMANA 3 |
|---------------------|----------|----------|----------|
| IGNACIO | 16 | 10 | 10 |
| DELANO | 9 | 10 | 15 |
| PACO | 9 | 12 | 8 |
| Franisco | 11 | 12 | 7 |
| Tamara | 15 | 9 | 11 |
| Jesus | 11 | 9 | 10 |
| TOTAL SEMANAL | 71 | 62 | 61 |
| TOTAL A LA FECHA | 71 | 133 | 194 |
| | -8 | +12 | -18 |
| PROMEDIO A LA FECHA | 11.8 | 11.08 | 10.77 |

| NOMBRE | SEMANA 1 | SEMANA 2 | SEMANA 3 | SEMANA 4 |
|---------------------|----------|----------|----------|----------|
| IGNACIO | 16 | 10 | 10 | |
| DELANO | 9 | 10 | 15 | |
| PACO | 9 | 12 | 8 | 11 17 |
| Franisco | 11 | 12 | 7 | 13 13 |
| Tamara | 15 | 9 | 11 | |
| Jesus | 11 | 9 | 10 | 13 9 |
| TOTAL SEMANAL | 71 | 62 | 61 | 76 |
| TOTAL A LA FECHA | 71 | 133 | 194 | 270 |
| | -8 | +12 | -18 | +24 |
| PROMEDIO A LA FECHA | 11.8 | 11.08 | 10.77 | 11.25 |

Finally, return to the Recorder's task of drawing the run chart and then upgrade it to a control chart. Here are the Spaniards' counts of red beads in time order:

16 9 9 11 15 11 10 10 12 12 9 9 10 15 8 7 11 10 11 13 13 17 13 9



As before, insert the two control limits to turn the run chart into a control chart and state your conclusions. Also as before, if you're on Stats-level 0 then simply look up the control limits on Appendix page 8; otherwise compute them in the space below.

(Again the computations are sketched in Technical Aid 4 on Appendix page 9.)

Regarding conclusions from the control charts, they are surely similar to those for Pause for Thought 2-e (on Appendix page 7) except that this time we would presumably comment on statistician John's 3 or Ignacio's 16 and Paco's 17 in similar ways to Ernie's 3—they're *all* within the control limits.

(Now continue straight on to Major Activity 2-h overleaf.)

Major Activity 2-h (pages 26–29) comes from Day 2 pages 38–41.

MAJOR ACTIVITY 2-h

Hopefully, you now have quite a long list of notes on learning-points from today's Red Beads Experiments, including some from Chapter 6 of *DemDim*.

At this early stage of the course, you probably do not have access to other sources. But if you do, or will be doing so before long, you may find plenty more messages to write up. Chapter 4 of Mary Walton's *The Deming Management Method* is excellent. Other sources are, of course, Dr Deming's own two books. In *Out of the Crisis* the most relevant pages are 295–302[346–354], although there are several more learning-points from the Red Beads Experiment further on in the book. Chapter 7 of *The New Economics* also describes and studies the Red Beads Experiment and ends with a list of no less than 14 "Lessons from the Red Beads". Deming ends that chapter by innocently remarking: "The reader may perceive Red Beads in his own company and in his own work." Finally, as previously mentioned, my recommended video material is Volumes 7 and 8 of *The Deming Library*.

However, even if you do not have any of these at present, you should by now still be able to produce a quite substantial summary of messages from the Red Beads Experiment.

So first review your notes on all that has happened today. If there were any gaps when you forgot to keep up your note-taking then have a look through the relevant sections and update your notes accordingly.

You may be quite used to trying to convert a collection of notes into a more organised form in preparation for writing up a report or some other kind of document. That is really what you should begin aiming to do here in order that you will finish up with an account which, when you refer back to it in the future, you will find easier to read and learn from.

But first, on Appendix pages 10–12 I have discussed some further messages from the Red Beads Experiment. You might possibly have touched upon one or two of these already, but I think you will also find some new issues in my write-up there. Usually I suggest that you do not turn to my discussions in the Appendix until you have already attempted the relevant Activity. However, in this case it may be better for you to read through that section at this stage. It could give you yet further thoughts to include in your account.

On your return from the Appendix, now spend a little time organising your notes into a small number of groups or categories, i.e. each containing somewhat related matters. Then develop your account of messages from the Red Beads Experiment by writing up a paragraph or two on each of those groups of notes. Finally "top and tail" your account with some appropriate introductory and concluding remarks.

(Page intentionally left blank for your account.)

(continued overleaf)

(Page intentionally left blank for your account.)



In conclusion, armed with your account, can you think of instances within your work-situation or elsewhere when you have been treated similarly to the way that the Willing Workers have been treated by the Foreman?

Even more importantly, if you are any kind of manager or in any role where you have supervisory responsibilities over others, can you identify situations where *you* have acted like the Foreman?

And, if so, how will your behaviour change from now on?



Continue near the bottom of Day 2 page 41.



←
(Stats-level 0 only)

DAY 3: UNDERSTANDING VARIATION AND THE FUNNEL EXPERIMENT

→
(Stats-levels 1–3)

Activity 3–a comes from Day 3 page 3.

ACTIVITY 3–a

Suggest some of the possible causes of variation in the arrival-time of my school bus.

Unsurprisingly, I do not have any data available from all those decades ago from which we could construct control charts. So, with each of the causes you've suggested above, simply say whether you *think* the cause is likely to have been common or special, and why. (Be guided by the paragraph on prison riots that we have just seen on Day 3 page 2.)

Being guided by the thoughts about prison riots, factors which result in somewhat random fluctuations from day to day would be interpreted as *common* causes, while relatively rare events which markedly affect the arrival time in a “one-off” manner would be interpreted as *special* causes. So e.g. if the bus is held up by a serious road accident or by freak weather conditions such as a flood or unusually heavy snowfall then we would regard these as special causes. On the other hand, normal fluctuations such as the number of people queuing at the bus-stops, the proportion of red traffic lights encountered along the journey, usual day-to-day variations in traffic-density, etc would be regarded as common causes.

(Continue straight on to Activity 3–b overleaf.)

Activity 3-b comes from Day 3 page 4.

ACTIVITY 3-b

There is a saying that “Variety is the spice of life”. This implies that *variety* is good. In the early pages of Day 3, we (and Dr Deming!) have been arguing that *variation* is bad.

Is there a conflict here? (*No, but clarify why not.*)

And how might *reducing variation* lead to *increasing variety*?

(For discussion see Appendix page 14.)

Continue on Day 3 page 5.

Activity 3-c comes from Day 3 page 6.

ACTIVITY 3-c

Day 3 page 5 ended with:

“Reduced variation! Better quality! Everything clearly within the specifications! *With that sensible and very expensive compensation device turned off!*”

How could this be?

(If you cannot answer this question now, be sure that you will be able to do so before you finish working through today's Major Activity!)



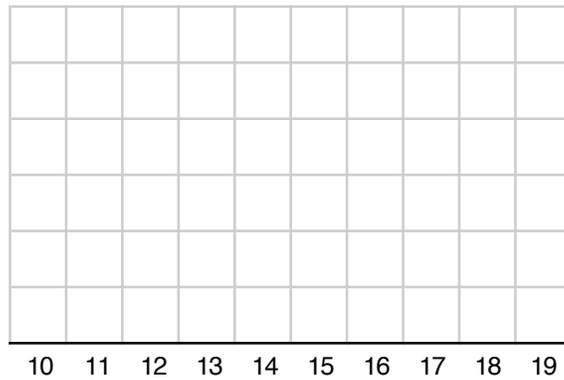
Continue on Day 3 page 7.

Activity 3-d comes from Day 3 page 7.

ACTIVITY 3-d

Here is another sequence of 24 numbers. Please sketch a histogram of these data. I suggest you use separate boxes as in the diagram on the left hand side of Day 3 page 7.

18 19 17 17 16 17 16 15 14 15 15 13 14 13 14 13 13 13 11 11 12 11 10 11



What do you conclude?

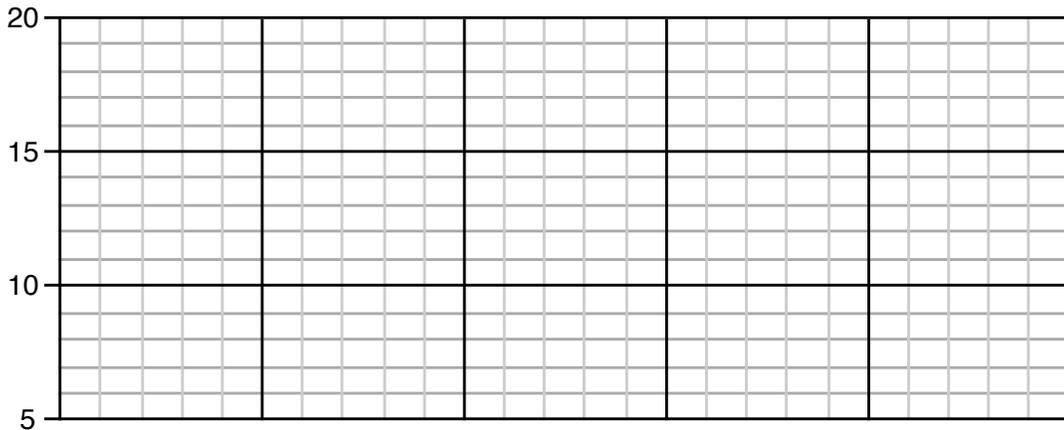
A “similar histogram”? It turned out to be the very *same* histogram as that obtained with the first set of data! Yet the processes were surely very different from each other. That is to say: the *behaviours of the two processes over time* were very different from each other.

Continue on Day 3 page 8.

Activity 3–e comes from Day 3 pages 8–9.

ACTIVITY 3–e

Now draw a run chart for the second process (data as in Activity 3–d opposite).



Compare and contrast the learning obtained from the two ways of pictorially representing data illustrated in Activities 3–d and 3–e.

Clearly, the first process was trending upward over time; the second was trending down. Very different behaviours. Yet we found exactly the same histogram in both cases. The two *collections* of numbers were exactly the same: they just occurred in a different order. But the *order* of the numbers is all-important for describing and understanding the behaviour of a process—it is foolish to ignore it.

***Histograms totally ignore the order in which the numbers come out of a process.
Yet that order is very likely to hold the most important information of all
about the process’s behaviour.***

Continue after the above comments on Day 3 page 9.

Pause for Thought 3-f comes from Day 3 page 10.

PAUSE FOR THOUGHT 3-f

Does the Ford example from earlier today (page 33 along with Day 3 page 5) suggest to you any concerns about the management's interpretation of yesterday's monthly sales data (Day 2 pages 1-3), the conclusions they drew, and the decisions they made?

This is not an exact analogy with the Ford example because, in that case, there was an "ideal" or "target" value, and the compensation device acted according to whether the value was above or below the target. Nevertheless, the management's behaviour here was somewhat analogous—generally acting one way if the figure went up and another way if it went down. The suspicion which the Ford example might therefore raise in our minds is that maybe such reactions could actually have *increased* the variation in the figures.

Continue near the bottom of Day 3 page 10.

Activity 3–g comes from Day 3 page 18.

ACTIVITY 3–g

Just for practice, compute the control limits by the method just demonstrated on Day 3 page 17 (again using just the first 12 values) on the data whose run chart you drew in Activity 3–e on page 35. Here again are those data for you:

18 19 17 17 16 17 16 15 14 15 15 13 14 13 14 13 13 13 11 11 12 11 10 11

(Hint: I deliberately chose those numbers to provide easy arithmetic for you—in particular, you should find that both \bar{X} and \overline{MR} computed from the first 12 values turn out to be whole numbers.)

(If you need to check your arithmetic then see Appendix page 15.)

Then insert the control limits on your run chart on page 35.

If you had needed the control limits to help you interpret the data, what would they have told you?



Continue on Day 3 page 19.

MAJOR ACTIVITY 3-h

This Major Activity occupies Day 3 pages 38–56. Here we include those sections where you are asked to complete tables, form histograms or draw run charts.

This table (pages 38–39) comes from Day 3 page 44.

| Stage number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---------------------------|-----------|-----------|-----------|-----------|-----------|----|---|---|---|----|----|----|----|----|
| Y is at | 30 | 27 | 29 | 31 | 30 | 33 | | | | | | | | |
| Dice-score = | 10 | 8 | 6 | 7 | 4 | | | | | | | | | |
| From Y, ● then goes | 3R | 1R | 1L | ↓ | 3L | | | | | | | | | |
| Outcome: ● is at | 33 | 28 | 28 | 31 | 27 | | | | | | | | | |
| As ● relative to ● is ... | 3R | 2L | 2L | 1R | 3L | | | | | | | | | |
| ... you move the funnel | 3L | 2R | 2R | 1L | 3R | | | | | | | | | |
| So Y is now at | 27 | 29 | 31 | 30 | 33 | | | | | | | | | |



| Stage number | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
|---------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Y is at | | | | | | | | | | | | | |
| Dice-score = | | | | | | | | | | | | | |
| From Y, ● then goes | | | | | | | | | | | | | |
| Outcome: ● is at | | | | | | | | | | | | | |
| As ● relative to ● is ... | | | | | | | | | | | | | |
| ... you move the funnel | | | | | | | | | | | | | |
| So Y is now at | | | | | | | | | | | | | |



(The final part of this table is on the next page.)

| Stage number | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|---------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 🔻 is at | | | | | | | | | | | | | |
| Dice-score = | | | | | | | | | | | | | |
| From 🔻, 🎲 then goes | | | | | | | | | | | | | |
| Outcome: 🎲 is at | | | | | | | | | | | | | |
| As 🎲 relative to 🎯 is ... | | | | | | | | | | | | | |
| ... you move the funnel | | | | | | | | | | | | | |
| So 🔻 is now at | | | | | | | | | | | | | |



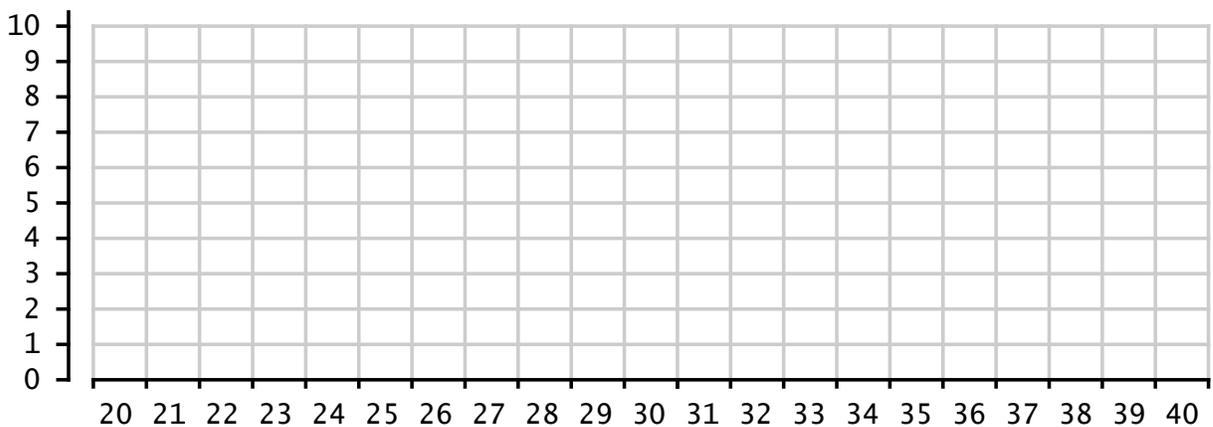
Continue on Day 3 page 45.



This space for the tally chart and histogram is an enlarged version of that on Day 3 page 45.

Tally chart

Histogram



Continue on Day 3 page 46.

This table come from Day 3 page 47.

| Stage number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-----------------------|-----------|-----------|-----------|-----------|-----------|----|----|----|----|----|----|----|----|----|
| Y is at | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| From Y, then goes | 3R | 1R | 1L | ↓ | 3L | | | | | | | | | |
| Outcome: is at | 33 | 31 | 29 | 30 | 27 | | | | | | | | | |

| Stage number | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
|-----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Y is at | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| From Y, then goes | | | | | | | | | | | | | |
| Outcome: is at | | | | | | | | | | | | | |

| Stage number | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|-----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Y is at | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| From Y, then goes | | | | | | | | | | | | | |
| Outcome: is at | | | | | | | | | | | | | |

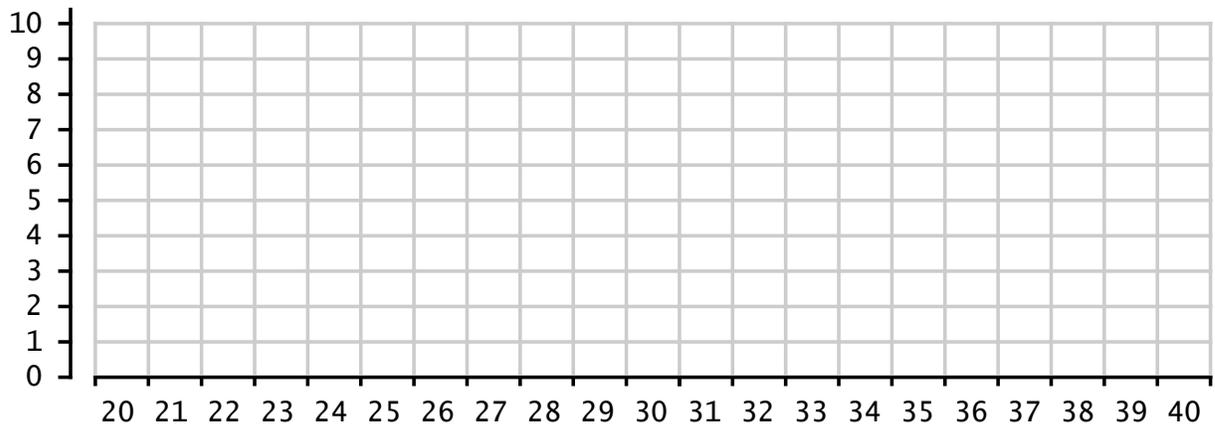


(There's no need for you to return to the Day 3 text here. Move straight on to carry out the tallying at the top of the next page and then summarise the data in a histogram as you have done on page 39.)

This space for the tally chart and histogram is an enlarged version of that on Day 3 page 47.

Tally chart

Histogram



Continue at the "Discussion" section beginning near the bottom of Day 3 page 47.

Pages 42–43 come from Day 3 pages 50–51.

| Stage number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-------------------------|-----------|-----------|-----------|-----------|-----------|----|---|---|---|----|----|----|----|----|
| Y is at | 30 | 27 | 32 | 29 | 31 | 32 | | | | | | | | |
| From Y, then goes | 3R | 1R | 1L | ↓ | 3L | | | | | | | | | |
| Outcome: is at | 33 | 28 | 31 | 29 | 28 | | | | | | | | | |
| As relative to is ... | 3R | 2L | 1R | 1L | 2L | | | | | | | | | |
| ... place Y relative to | 3L | 2R | 1L | 1R | 2R | | | | | | | | | |
| So Y is now at | 27 | 32 | 29 | 31 | 32 | | | | | | | | | |

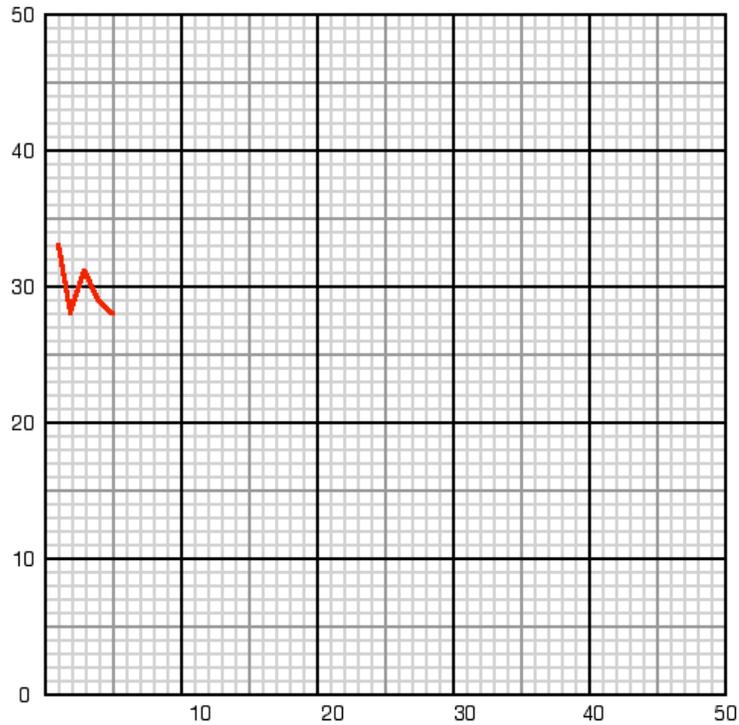
NB By now you may already have realised that you can again short-circuit the two rows beneath the yellow-shaded “Outcome” row, in this case by using the symmetric property emphasised on Day 3 pages 48–49. This is equivalent to immediately writing in the bottom “So Y is now at” row the number which, when added to the “Outcome” number, totals 60. That’s quicker! Confirm that it’s true in the first part of the table above, and then continue to use it if you like it. As soon as you are happy with it, you can skip the two rows under the yellow-shaded row and proceed straight down to the bottom row. Or if you are not happy, carry on using those two rows.

| Stage number | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
|-------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Y is at | | | | | | | | | | | | | |
| From Y, then goes | | | | | | | | | | | | | |
| Outcome: is at | | | | | | | | | | | | | |
| As relative to is ... | | | | | | | | | | | | | |
| ... place Y relative to | | | | | | | | | | | | | |
| So Y is now at | | | | | | | | | | | | | |

| Stage number | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|-------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Y is at | | | | | | | | | | | | | |
| From Y, then goes | | | | | | | | | | | | | |
| Outcome: is at | | | | | | | | | | | | | |
| As relative to is ... | | | | | | | | | | | | | |
| ... place Y relative to | | | | | | | | | | | | | |
| So Y is now at | | | | | | | | | | | | | |

And now draw the run chart, continuing on from my first five points. Again, as with the histograms, there's no need to be too artistic about it—please yourself whether or not you use a ruler!

Rule 3



Recall that the very first stage in Rule 3 was identical to that in Rule 2 but, as was pointed out at the time, this was simply because the funnel was initially at its “sensible” value of 30. I imagine, however, that you subsequently discovered things changed with Rule 3 You may recall Peter Worthington’s observation (page 29) that a zig-zag pattern is *not* random variation!

Continue on Day 3 page 52.

Pages 44–45 come from Day 3 pages 54–55.

| Stage number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-----------------------|-----------|-----------|-----------|-----------|-----------|----|---|---|---|----|----|----|----|----|
| Y is at | 30 | 33 | 34 | 33 | 33 | 30 | | | | | | | | |
| From Y, then goes | 3R | 1R | 1L | ↓ | 3L | | | | | | | | | |
| Outcome: is at | 33 | 34 | 33 | 33 | 30 | | | | | | | | | |
| So move Y to | 33 | 34 | 33 | 33 | 30 | | | | | | | | | |

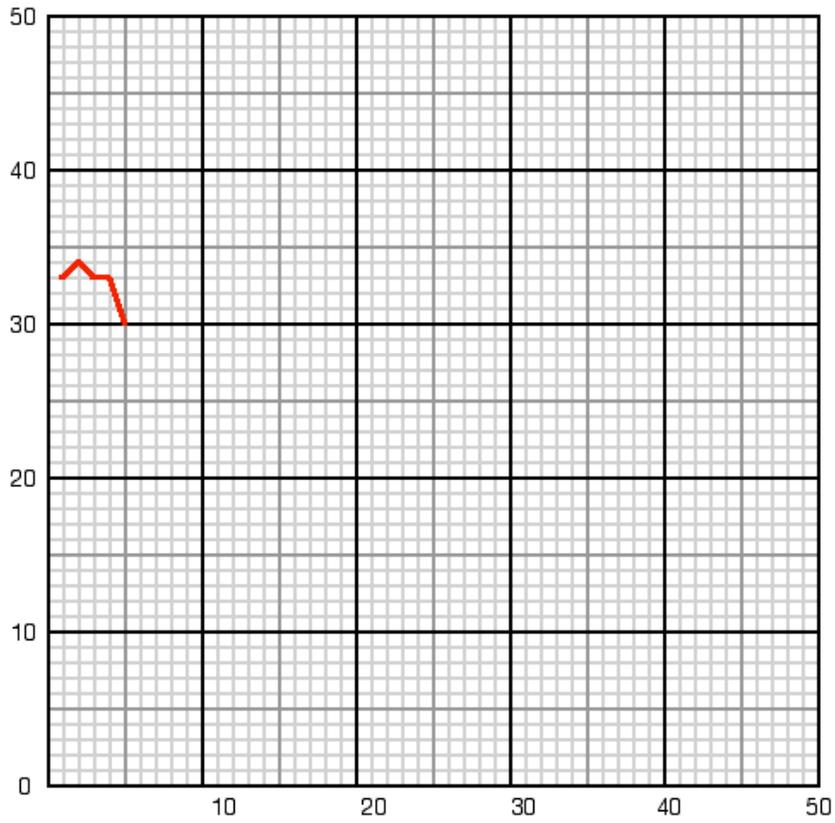
| Stage number | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
|-----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Y is at | | | | | | | | | | | | | |
| From Y, then goes | | | | | | | | | | | | | |
| Outcome: is at | | | | | | | | | | | | | |
| So move Y to | | | | | | | | | | | | | |

| Stage number | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|-----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Y is at | | | | | | | | | | | | | |
| From Y, then goes | | | | | | | | | | | | | |
| Outcome: is at | | | | | | | | | | | | | |
| So move Y to | | | | | | | | | | | | | |



(And now move straight on to the run chart on the next page:)

Rule 4



Continue on Day 3 page 56.

Activity 3-i comes from Day 3 page 57.

ACTIVITY 3-i

Having spent much of this morning on beginning to get used to control charts and now this afternoon on the Funnel Experiment, this is a useful Activity which involves both of them. However, if you are a Stats-level 0 student then this possibly isn't for you.

Let's first précis the "How Do We Compute Those Control Limits—and Why?" section on Day 3 pages 13–15 as follows:

"Control limits need to indicate the range over which the data will vary when the process is in statistical control: so that, if and when data go outside those limits, we have evidence that the process may well be out of statistical control. But suppose the process is *out of* statistical control when we collect those data. The method we use is based on 'moving ranges'. Obviously, if many of these moving ranges are large then high variation is indicated; whereas if the moving ranges are mostly small then low variation is indicated. Using moving ranges works pretty well in mitigating the contamination effects of many kinds of special causes. There are a few exceptions. Two important exceptions that one needs to be able to recognise are illustrated with data generated in the Funnel Experiment, and so we shall see those this afternoon."

With these thoughts in mind, imagine that you are computing control limits (using moving ranges) from data that are being generated from each of the four Rules of the Funnel in turn. How do you think those data will affect the control limits, and what would happen if you extended those limits into the future during which the same Rule is in operation?

Rule 1

Rule 2

Rule 3

Rule 4

(For discussion see Appendix pages 18–20.)



Continue at the top of Day 3 page 58.

Activity 3-j comes from Day 3 page 58.

ACTIVITY 3-j

Now that you have completed the Major Activity and after reading *DemDim* Chapter 5, it would be good if you could spend the final few minutes summarising some illustrations of your own. You will find further suggestions in the relevant discussion in the Appendix – but don't look at it just yet!

It is often not possible to differentiate between Rules 2 and 3 when suggesting examples. As we have seen, in effect the difference between them depends on whether the tampering is done comparatively sensibly or completely stupidly! Also, the performances of some practical illustrations are worse than Rule 2 but not as berserk as Rule 3! I would recommend therefore that, in addition to a list of possibilities for Rule 4, you simply compile one other list to cover both Rules 2 and 3 to thus include any kind of "zig-zag" or "swinging the pendulum" compensation effect. Further, the Rule 4 list does not need to be restricted to a *strict* version of Rule 4. For example, a photocopy of a photocopy of a photocopy of ... is similar to Rule 4 except that it continually moves away from the target (the original copy) rather than being able to temporarily move back toward it.

(For some final examples see Appendix pages 20–21.)

To conclude, there is a short paragraph at the bottom of Day 3 page 58.

