LEVELING RESOURCES IN SERIES

First priority? Second priority?

Act	T	Resource 1		Resource 2	
		Rate	Res Day	Rate	Res Day
ST	0	—	—	—	—
A	2	0	0	2	4
B	5	2	10	3	15
C	3	2	6	0	0
D	2	1	2	4	8
E	6	2	12	5	30
F	6	3	18	2	12
G	6	1	6	0	0
H	4	0	0	5	20
K	2	4	8	5	10
L	7	2	14	0	0
M	3	2	6	8	24
N	2	4	8	3	6
P	2	0	0	0	0
			$\Sigma y = 90$		$\Sigma y = 129$

In construction projects: Leveling one resource tends to level other resources, too, due to resource dependencies.

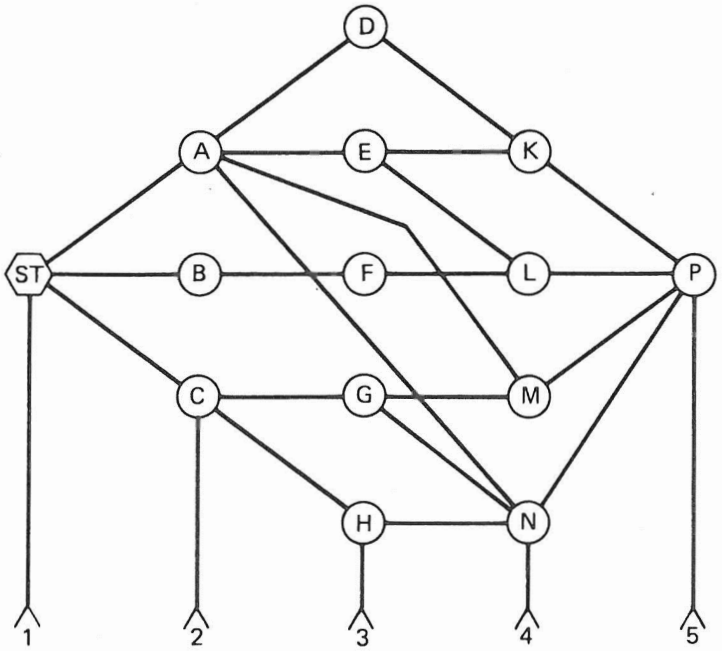


Figure 11.16 Leveling network with two resources.

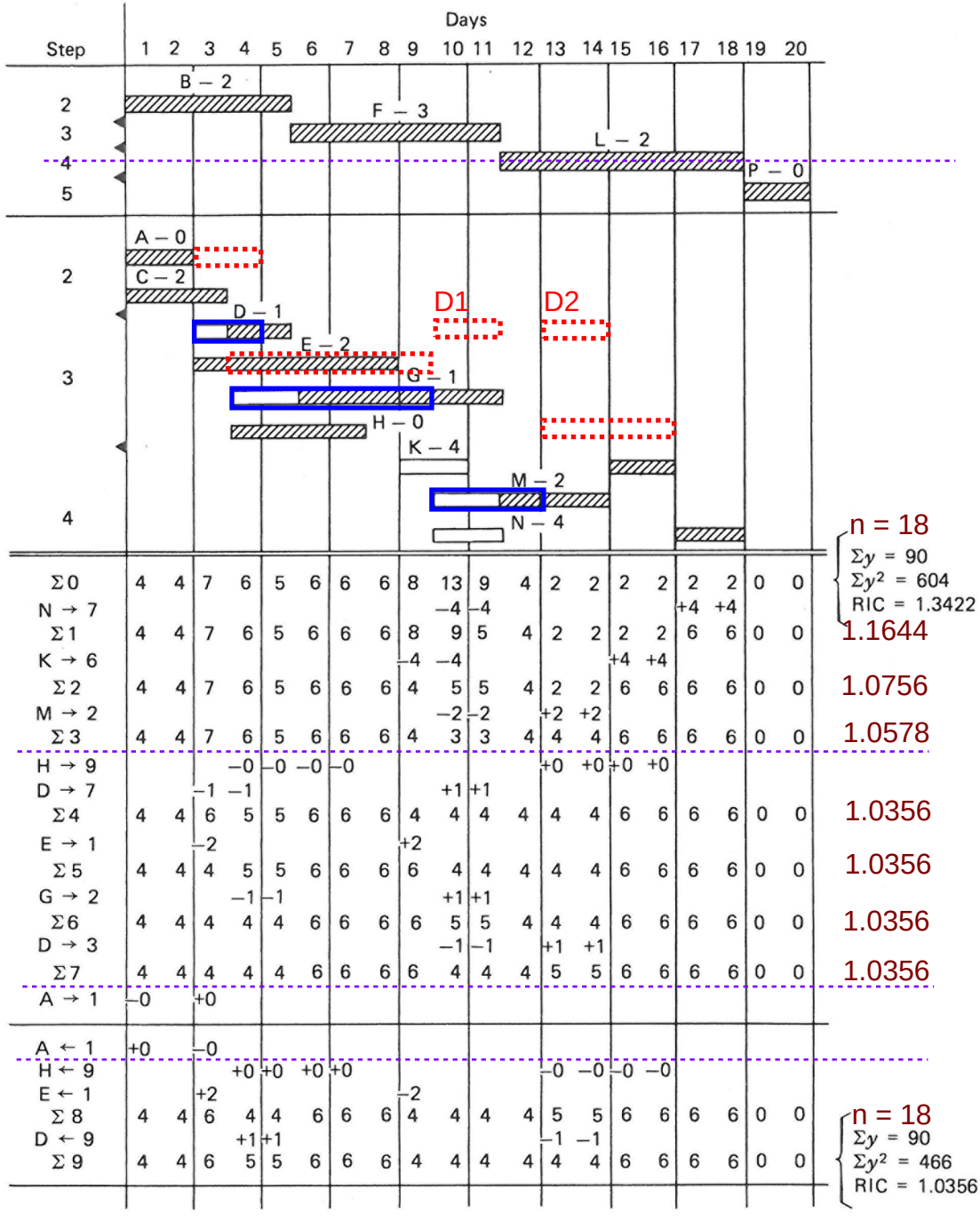


Figure 11.17 Leveling Resource 1.

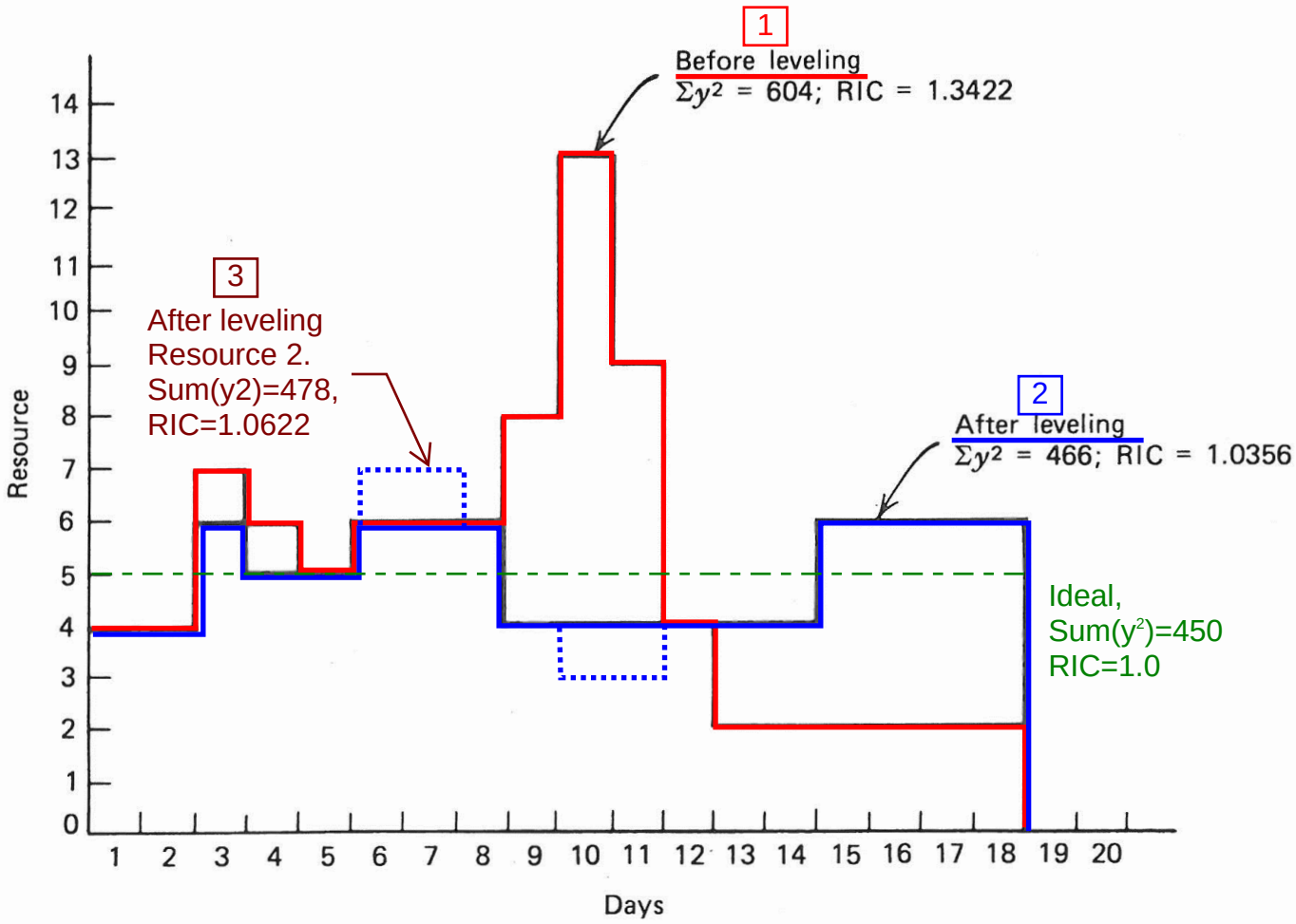


Figure 11.18 ***Histogram for leveling Resource 1.***

Note: RIC calculations use n=18 (not n=20) because Act. P has r=0 for days 19 & 20.

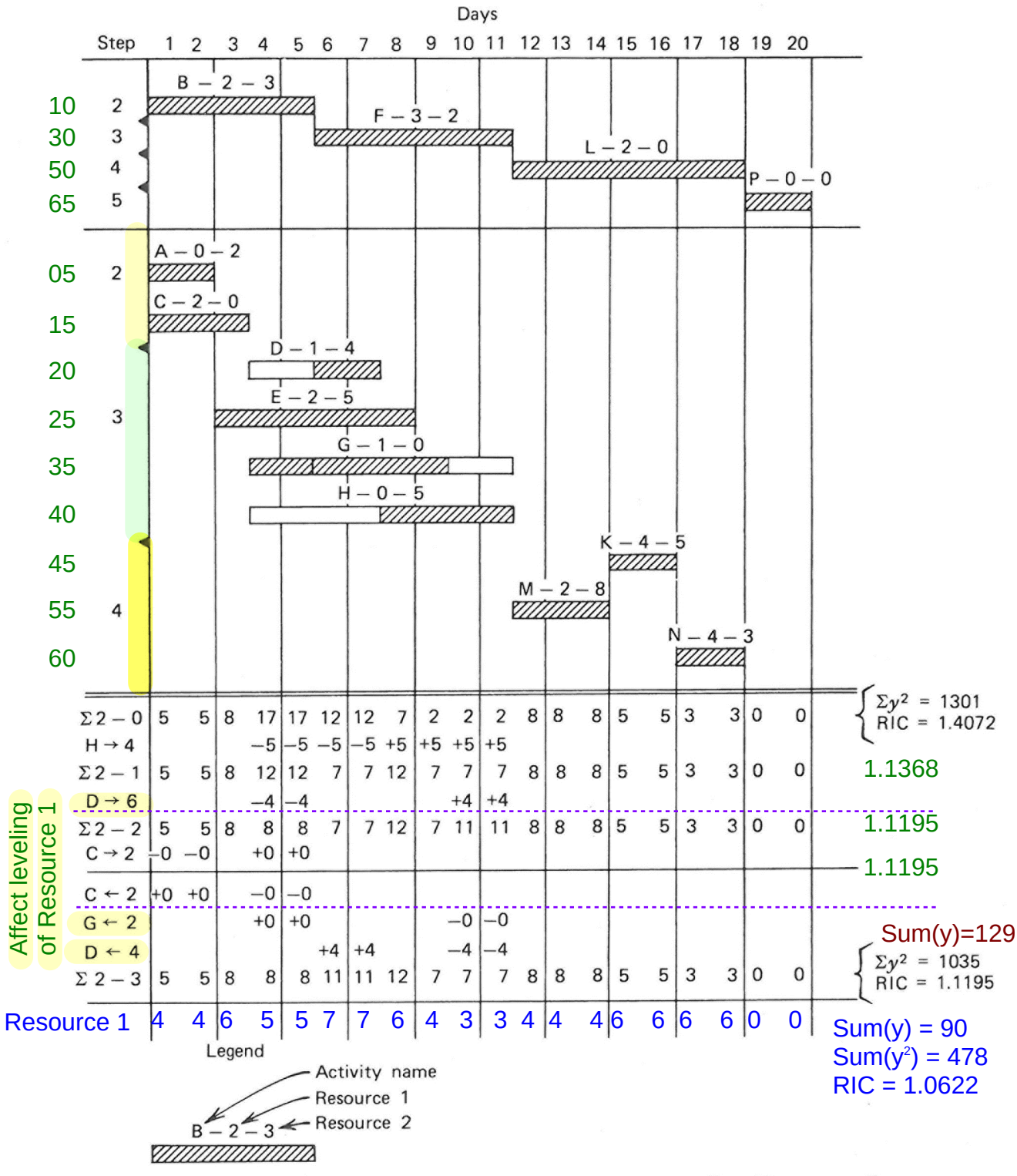


Figure 11.19 Leveling Resource 2 after leveling Resource 1.

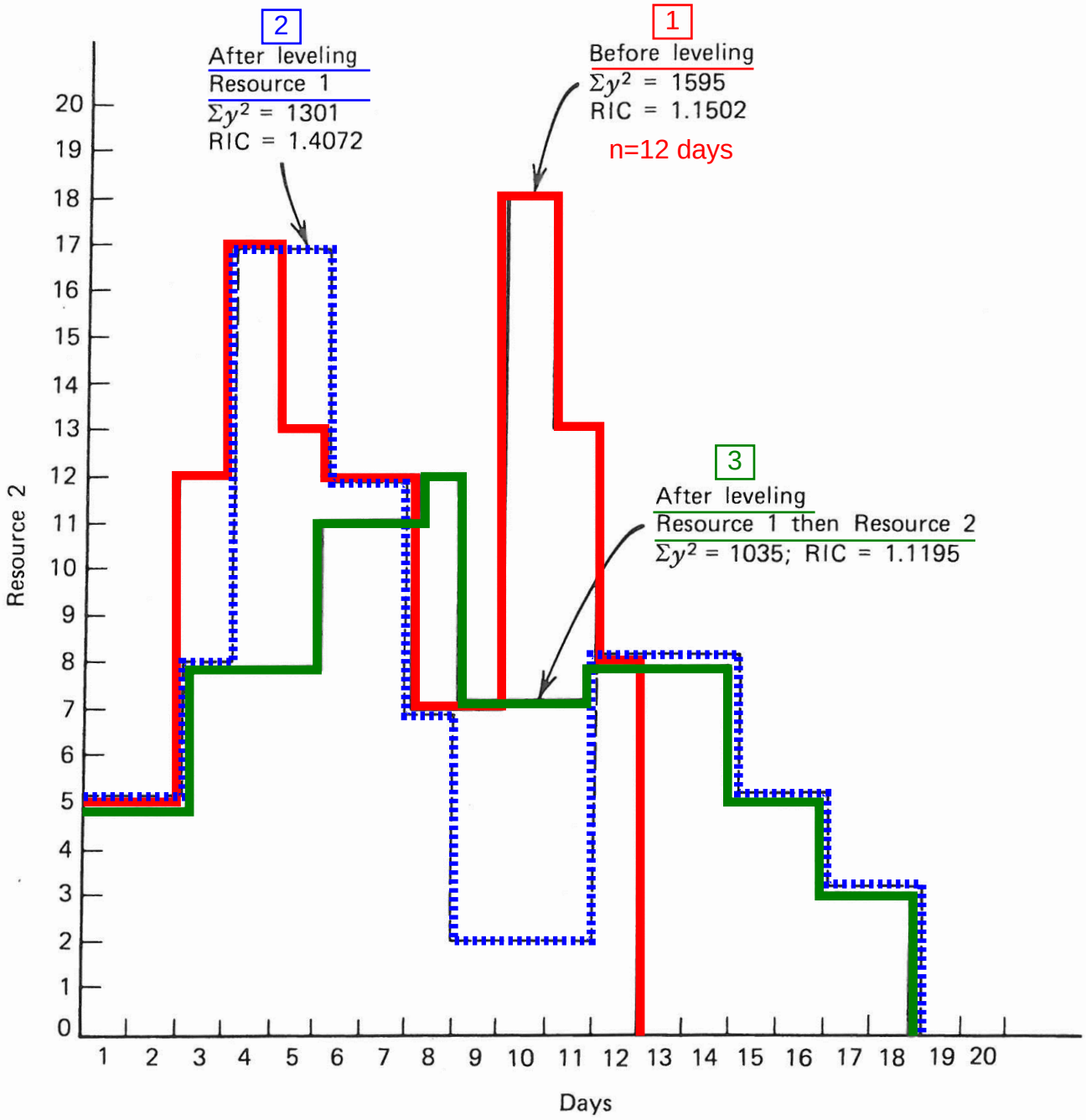


Figure 11.20 ***Histograms for Resource 2.***

EFFECT OF RESOURCE LEVELING ORDER

	Resource 1				Resource 2			
	$\sum y_i^2$	$\Delta\sum y_i^2$	*RIC*	Δ*RIC*	$\sum y_i^2$	$\Delta\sum y_i^2$	*RIC*	Δ*RIC*
No leveling	604	+138 29.61%	1.342	0.3062 29.55%	1595	+624 64.3%	1.1502	+0.1 9.5%
Level 1 only	466		1.036					
Level 2 only					971		1.0503	
Level 1, then 2	478	+12 2.57%	1.062	0.026 2.51%	1035	+64 6.6%	1.120	+0.07 6.7%
Level 2, then 1	466		1.036		1211	+240 24.7%	1.31	+0.26 24.7%
Add 1&2 and level	472	+6 1.28%	1.049	0.013 1.25%	1051	+80 8.2%	1.1368	+0.086 8.2%
Adjust, add and level	468	+2 0.43%	1.040	0.004 0.39%	1121	+150 15.4%	1.2125	+0.16 15.231%

TABLE 11.4

Leveling Summary

Leveling Case	Resource 1 Σy^2	Resource 1 RIC	Resource 2 Σy^2	Resource 2 RIC
1. No leveling Res. 1: $\Sigma y = 90$; $\Sigma\Delta = 24$ Res. 2: $\Sigma y = 129$; $\Sigma\Delta = 43$	604	1.3422	1595	1.1502
2. Resource 1 alone	466	1.0356	—	—
3. Resource 2 alone	—	—	971	1.0503
4. Resource 1 then 2	478	1.0622	1035	1.1195
5. Resource 2 then 1	466	1.0356	1211	~~1.0399~~ 1.31
6. Resource 1 and 2 (Natural weighting)	472	1.0489	1051	1.1368
7. Resource 1 and 2 (Res. 1 WTD 2.69x)	468	1.0400	1121	1.2125

LEVELING TO A PREFERRED HISTOGRAM

Preferred Histogram (Desired Histogram Shape for Resource 1)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
y_i	0	2	2	4	4	6	8	8	10	13	13	14	12	10	8	8	4	0	0	0	$\Sigma y = 126$
Δ		0	2	0	2	2	0	2	3	0	1	2	2	2	0	4					$\Sigma\Delta = 22$

n=16

Characteristics of the original histogram for Resource 1

$\Sigma y = 90$, $\Sigma\Delta = 24$, and $n = 18$.

To give the preferred histogram equal weight in leveling, its ∑Δ must be increased to ∑Δ=24 and its *n* must be increased to *n*=18 to match the characteristics of the original histogram for Resource 1.
Judgment is used to modify the preferred histogram to that shown below.

Modified Preferred Histogram to match Histogram for Resource 1

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
y_i	1	3	3	3	3	6	8	8	10	13	13	13	10	10	9	8	4	1	0	0	$\Sigma y = 126$
Δ		2	0	0	0	3	2	0	2	3	0	0	3	0	1	1	4	3			$\Sigma\Delta = 24$

n=18

The Modified Preferred Histogram must now be "debased" to decrease its area from ∑y=126 to ∑y=90 to match the histogram for Resource 1. Debase by (126-90)/18 = 2 to produce the "virtual profile" below.

Virtual Histogram to be subtracted from Histogram for Resource 1

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
y_i	−1	1	1	1	1	4	6	6	8	11	11	11	8	8	7	6	2	−1	0	0	$\Sigma y = 90$
Δ		2	0	0	0	3	2	0	2	3	0	0	3	0	1	1	4	3			$\Sigma\Delta = 24$

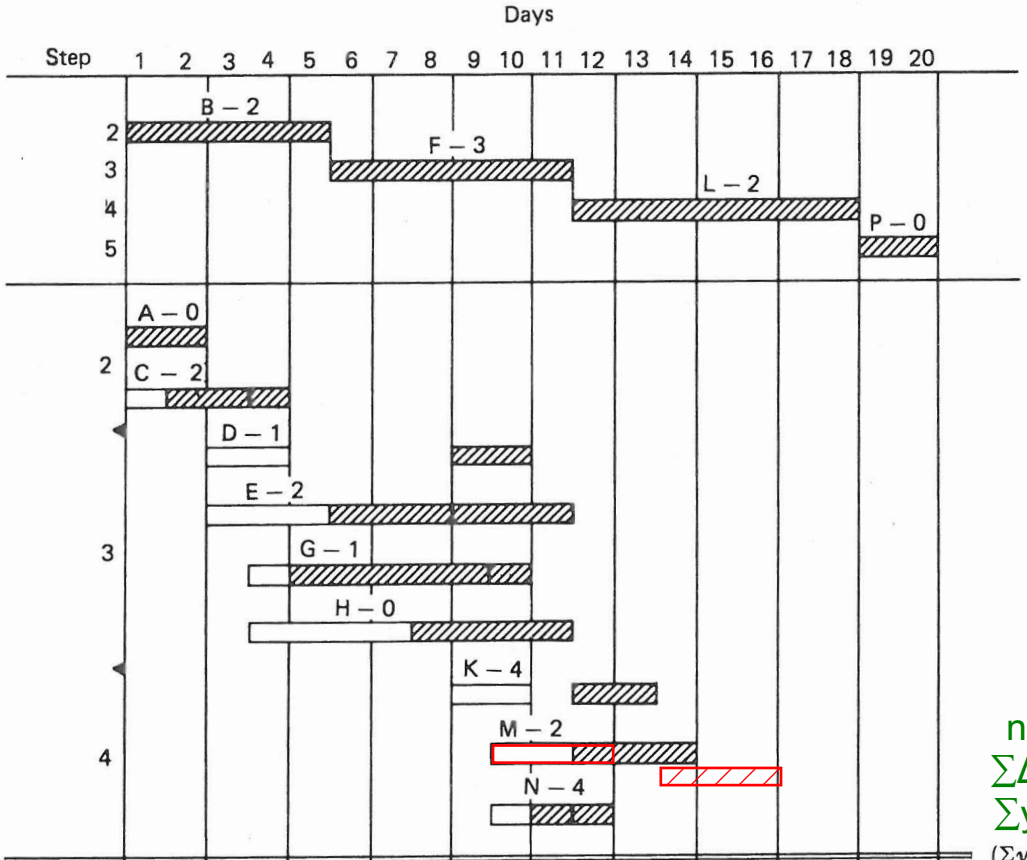
n=18

Steps:
- Subtract the Virtual Profile from the Resource 1 Profile (histogram).
- Perform the Min Moment Method (which attempts to make the top of the histogram flat and equal to zero).
- Add the Virtual Profile back to get the leveled Resource 1 Profile.

Sample IF calculations for Act. K are shown on the right.

Act. K; $r = 4$; FF = 8

IF (K, 1) = 4(0 + 2 − 4) = −8
IF (K, 2) = 4(2 + 9 − 8) = 12
IF (K, 3) = 4(2 + 13 − 8) = (28)
IF (K, 4) = 4(2 + 12 − 8) = 24
IF (K, 5) = 4(2 + 11 − 8) = 20
IF (K, 6) = 4(2 + 9 − 8) = 12
IF (K, 7) = 4(2 + 4 − 8) = −8
IF (K, 8) = 4(2 − 3 − 8) = −36



∑y=90	Σ0	4	4	7	6	5	6	6	6	8	13	9	4	2	2	2	2	2	2	0	0
-∑y=90	Virtual(–)	–1	1	1	1	1	4	6	6	8	11	11	11	8	8	7	6	2	–1	0	0
∑y=0	NewΣ0	5	3	6	5	4	2	0	0	0	2	–2	–7	–6	–6	–5	–4	0	3	0	0
IF=28	K → 3									–4	–4		+4	+4							
	Σ1	5	3	6	5	4	2	0	0	–4	–2	–2	–3	–2	–6	–5	–4	0	3	0	0
IF=4	M → 4									–4	–2	–2	–2		+2	+2	+2				
	Σ2	5	3	6	5	4	2	0	0	-4	–4	–4	–5	–2	–4	–3	–2	0	3	0	0
r=0	H → 2				–0	–0			+0	+0											
IF=42	E → 3			–2	–2	–2				+2	+2	+2									
	Σ3	5	3	4	3	2	2	0	0	–2	–2	–2	–5	–2	–4	–3	–2	0	3	0	0
IF=9	D → 7			–1	–1						+1	+1									
	Σ4	5	3	3	2	2	2	0	0	–2	–1	–1	–5	–2	–4	–3	–2	0	3	0	0
r=0	A → 3	–0	–0		+0	+0															
IF=0	N → 1										–4		+4								
	Σ5	5	3	3	2	2	2	0	0	–2	–5	–1	–1	–2	–4	–3	–2	0	3	0	0
r=0	H → 1						–0				+0										
IF=6	G → 1				–1						+1										
	Σ6	5	3	3	1	2	2	0	0	–2	–4	–1	–1	–2	–4	–3	–2	0	3	0	0
IF=4	C → 1	–2			+2																
	Σ7	3	3	3	3	2	2	0	0	–2	–4	–1	–1	–2	–4	–3	–2	0	3	0	0
r=0	A ← 3	+0	+0		–0	–0															
r=0	H ← 2					+0	+0			–0	–0										
IF=0	D ← 1									+1		–1									
	Σ8	3	3	3	3	2	2	0	0	–1	–4	–2	–1	–2	–4	–3	–2	0	3	0	0
	Virtual(+)	–1	1	1	1	1	4	6	6	8	11	11	11	8	8	7	6	2	–1	0	0
	Final Σ9	2	4	4	4	3	6	6	6	7	7	9	10	6	4	4	4	2	2	0	0

n=18
∑Δ=24
∑y=90
$\sum y^2 = 604$
RIC = 1.3422

Static Moment of NewΣ0 before leveling M0= 147

The "before" RIC=1.3422 and "after" RIC = 1.2 are not meaningful.

Static Moment of Σ8 after leveling M1= 54
M1/M0 = 54/147 = 37%

$\sum y^2 = 540$
RIC = 1.2000

Figure 11.26 Leveling to a preferred histogram.

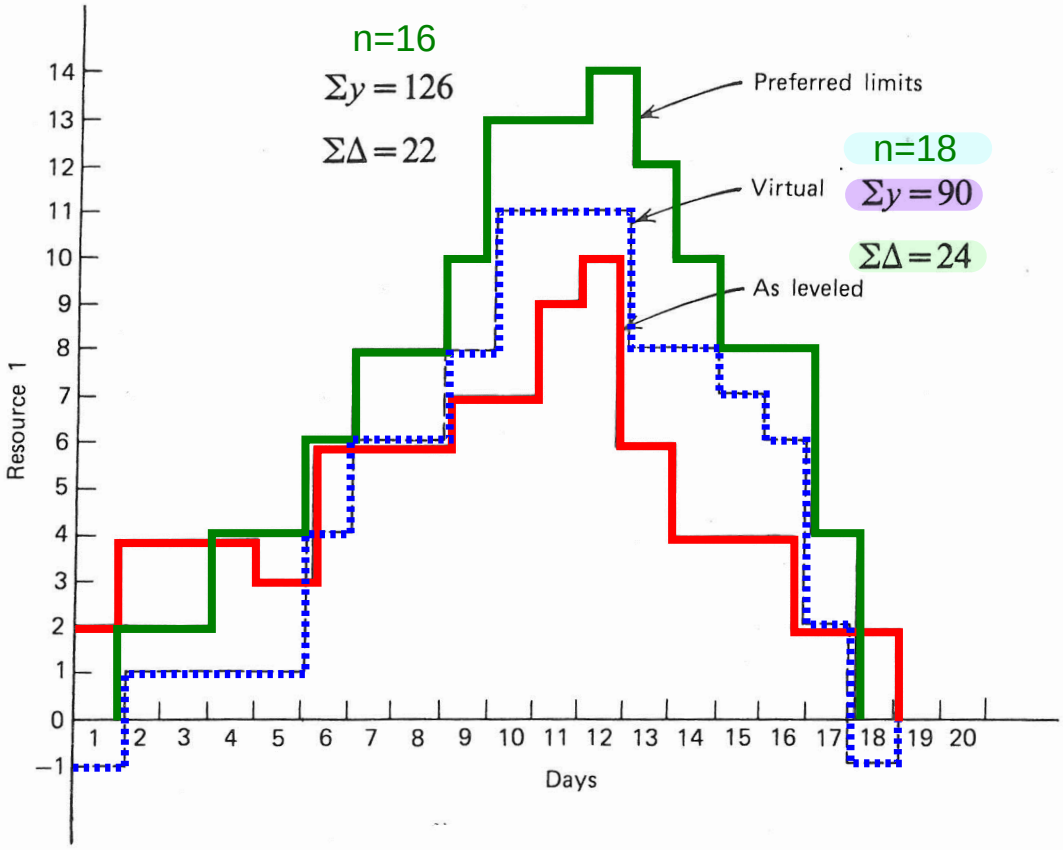


Figure 11.27 Histograms after leveling to preferred limits.

TABLE 11.4

Leveling Summary

Leveling Case	Resource 1 Σy^2	Resource 1 RIC	Resource 2 Σy^2	Resource 2 RIC
1. No leveling Res. 1: $\Sigma y = 90$; $\Sigma\Delta = 24$ Res. 2: $\Sigma y = 129$; $\Sigma\Delta = 43$	604	1.3422	1595	1.1502
2. Resource 1 alone	466	1.0356	—	—
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6. Resource 1 and 2 (Natural weighting)	472	1.0489	1051	1.1368
7. Resource 1 and 2 (Res. 1 WTD 2.69x)	468	1.0400	1121	1.2125