CONSTRUCTION PLANNING AND SCHEDULING

COTM4221

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DECEMBER 2019

Chapter Three

LoB Method

Introduction

Linear Scheduling

- ✓ **Linear scheduling methods are planning and scheduling techniques, mostly used in industries where operations are of repetitive nature.**
- ✓ **The line-of-balance (LOB) technique is a linear scheduling method that allows the balancing of the operations such that each activity is continuously and efficiently performed in each consecutive unit.**
- ✓ **Some construction projects that involve sets of tasks organized in repeating sequences are similar to continuous manufacturing processes in their structure.**

LoB.....

- ✓ **Many construction projects incorporate a high degree of repetitive tasks. Such projects include high-rise residential and commercial buildings, hotels, housing estates, and infrastructure projects such as roads, railways, and pipelines.**
- ✓ **Line of Balance focuses on the repetitive elements within such projects.**
- ✓ **The LOB technique was originated by the Goodyear Company in the early 1940s and was developed by the US Navy in the early 1950s, for the programming and control of both repetitive and non-repetitive projects.**
- ✓ **The basic concepts of LOB have been applied in the construction industry as a planning and scheduling method.**

LoB.....

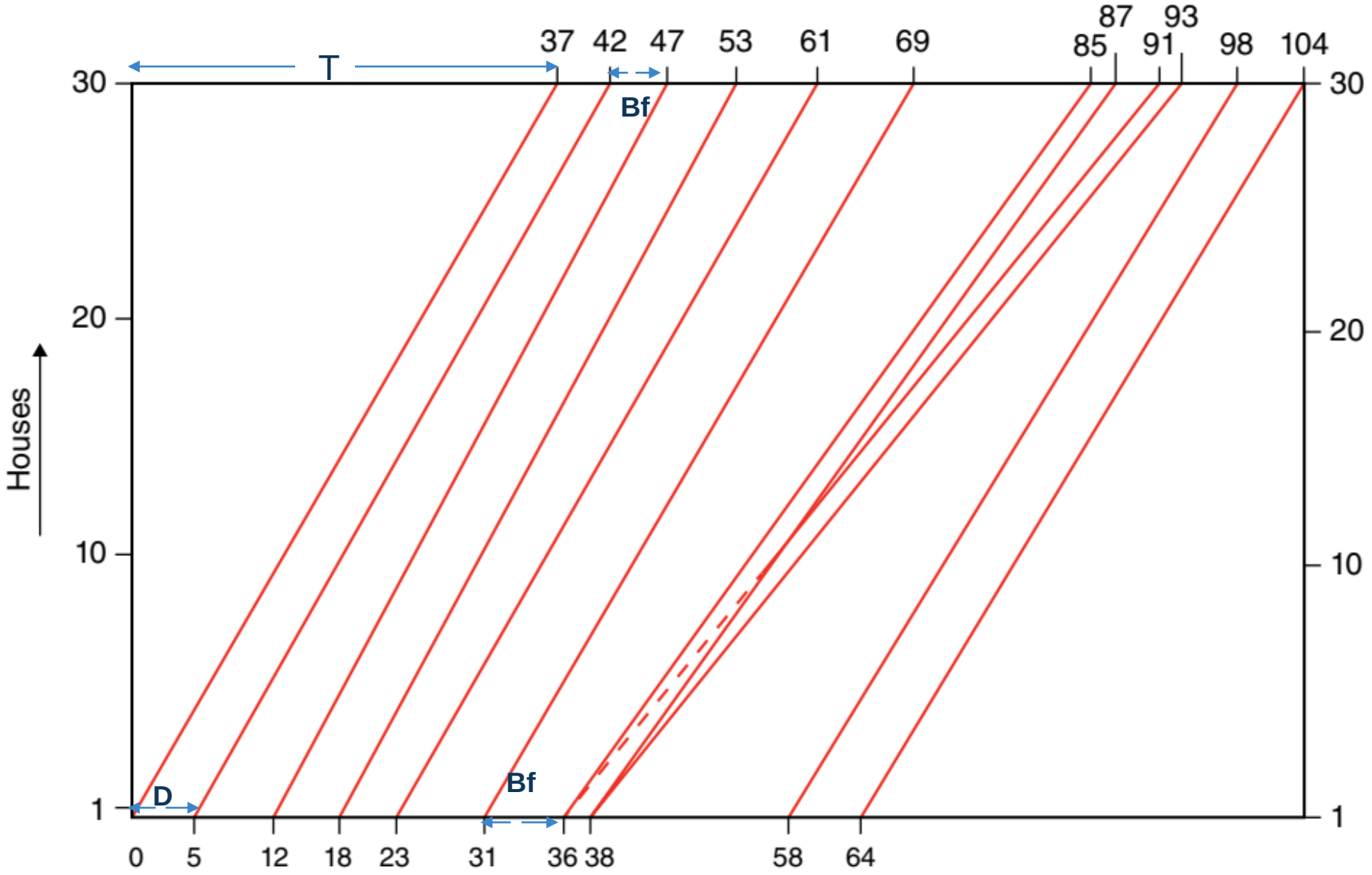
- ✓ **The purpose of the LOB method is to ensure that the many activities of a repetitive production process stay "in balance" that is, they are producing at a pace which allows an even flow of the items produced through a process and at a speed compatible with the goals set forth in a plan.**
- ✓ **Working from a required production output the technique calculates the production rates and resources necessary to meet project deadlines.**

LoB.....

Assumptions:

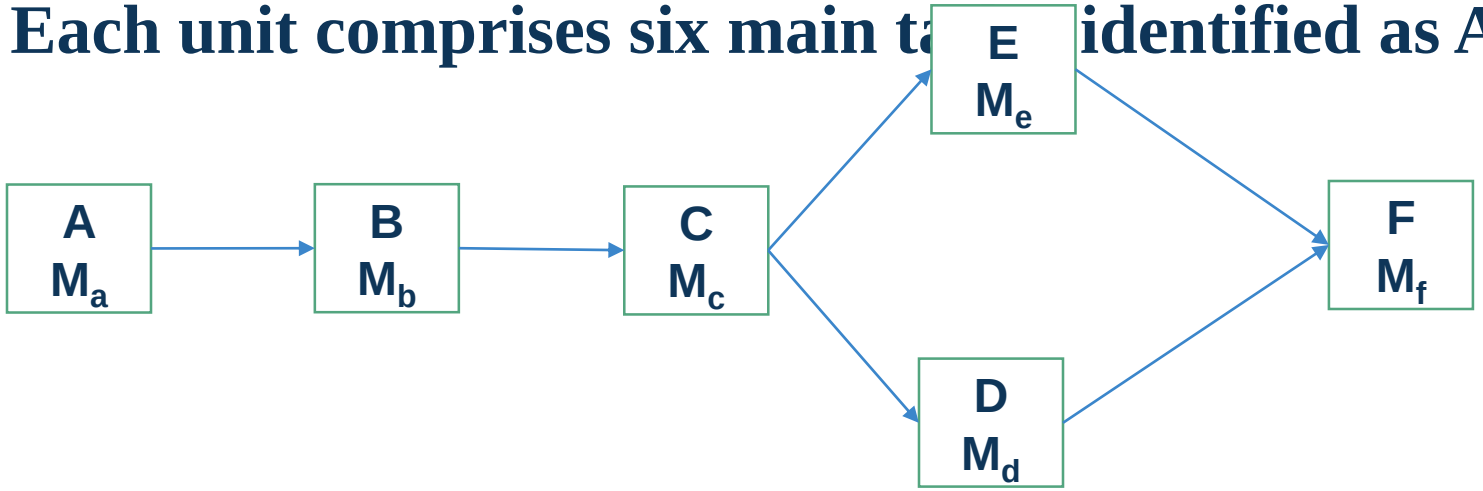
- ✓ **The line-of-balance technique is based on the underlying assumption that the rate of production for an activity is uniform and the lines are drawn straight.**
- ✓ **In other words, the production rate of an activity is linear where time is plotted on one axis, usually horizontal, and units or stages of an activity on the vertical axis. The production rate of an activity is the slope of the production line, and is expressed in terms of units per timed.**
- ✓ **The LOB technique can accommodate single work crews or multiple work crews.**
- ✓ **The 'buffers' between activities may represent specific time allowances (e.g. the time allowed for the curing of concrete) or serve as contingencies, for example, the moving of location and the setting up of equipment.**

LoB of 30 houses



LoB.....

- ✓ The above figure shows an LOB diagram for the completion of 30 units of construction. (e.g. 30 houses.)
- ✓ The diagram shows that after construction starts it takes 64 working days to complete the first unit.
- ✓ Handover of the completed 30 units will take place after 104 days.
- ✓ Each unit comprises six main ta identified as A–F.



LoB Diagram.....

Activity	Man Hour Per Unit **(M)**	Men Per Gang **(m)**	Theoretical Gang Size at the Chosen Output Rate **(G)**	Actual Gang Size **(G_a)**	Actual Output Rate **(R_a)**	Activity Duration For One Unit **(D)**	Time from Start on Fist Unit to Start on Last Unit **(T)**
A							

- **(M) is the required number of hours work required in the Activity in each house.**
- **The Men per Gang (m) is the total number of men to work on each Activity in each unit.**
- **(G) is the theoretical gang size required to produce the required output**
  - **$G = (R \times M)/H$.**
- **(G_a) must be a multiple of m selected as close as possible to the theoretical gang size.**
- **(R_a) = (G_a/G) × R. Where R is the target rate of construction per unit time.**
- **D = (M/m*h) is the time to complete the activity in one unit based on the Actual Gang Size. h=working hour per day per men.**
- **T = ((n-1) × d)/ R_a. d= number or working days per week**

Example One

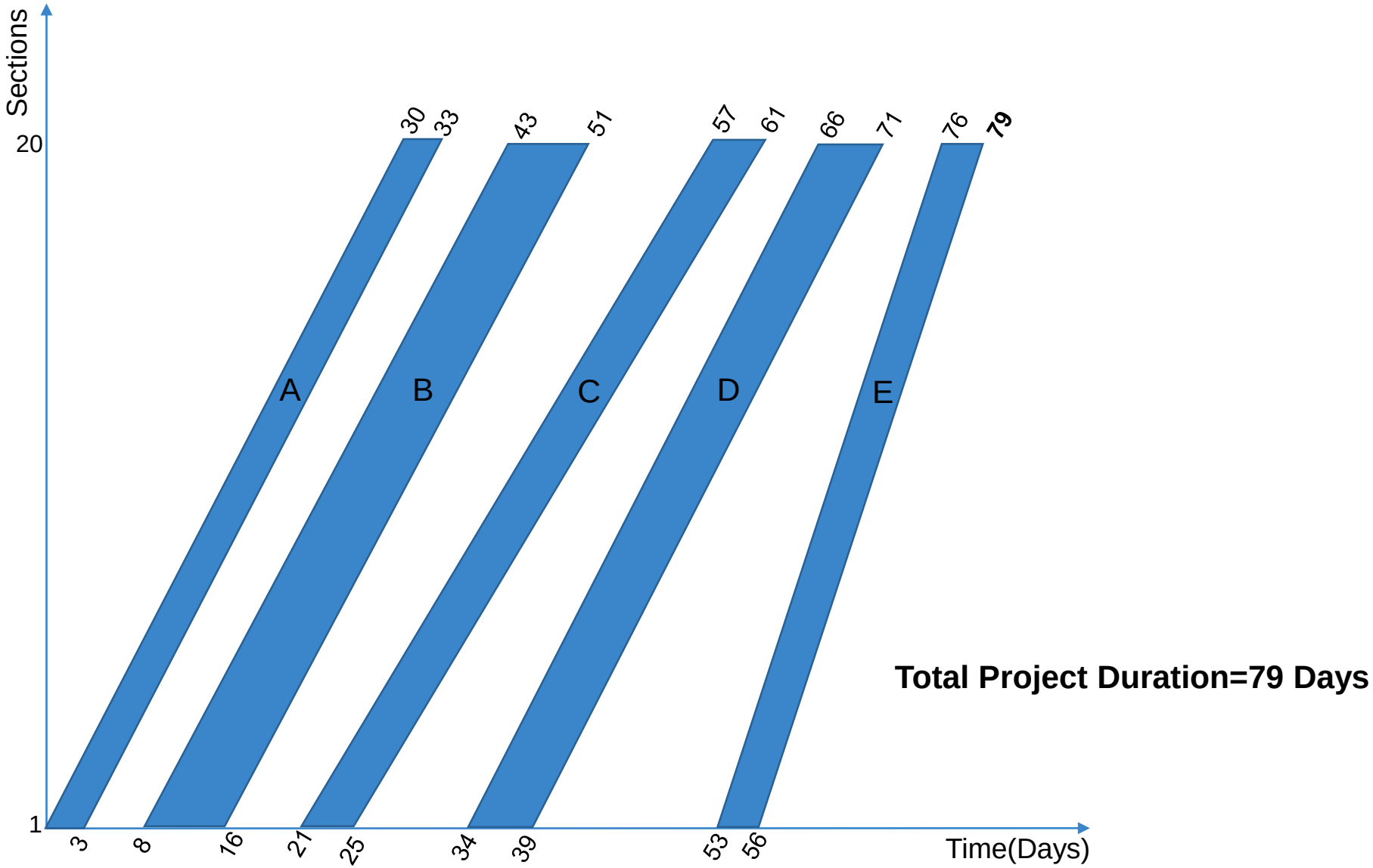
Draw a LoB diagram and calculate the total duration for a repetitive that includes the activities shown in the following Table that are repeated in 20 units. The target rate for completion of these houses is three houses per week. A working week comprises five 8-h days and 5 days per week. It is assumed that there is a minimum buffer time of 5 days between each activities. The productivity demand is 3 sec per week.

Activity	IPA	Man Hour Per Unit	Men Per Gang
A		100	4
B	A	350	6
C	B	60	2
D	C	200	5
E	D	150	8

Solution

Activity	Man Hour Per Unit	Men Per Gang	Theoretical Gang Size at the Chosen Output Rate	Actual Gang Size	Actual Output Rate	Activity Duration For One Unit	Time from Start on Fist Unit to Start on Last Unit
A	100	4	7.5	8	3.20	3.1≈3	29.7≈30
B	350	6	26.25	24	2.74	7.3≈8	34.6≈35
C	60	2	4.5	4	2.67	3.8≈4	35.6≈36
D	200	5	15	15	3.00	5.0	31.7≈32
E	150	8	11.25	16	4.27	2.3≈3	22.3≈23

Solution



Total Project Duration=79 Days

Example One…

Questions :

a. **What is the total duration of the project?**

Answer: 79 working Days

b. **When will be the finished day of house number one?**

Answer: After 56 working days

c. **When will be the finished day of house number five?**

Answer: $Slope(R_A)$**=4.27 unit/week=0.854unit/day=**$\frac{5-1}{X-56}$

X=60.68≈ After 61 days

After 56 working days

d. **When will Act.C will be fully completed in all houses?**

Answer: At the end of working day 61

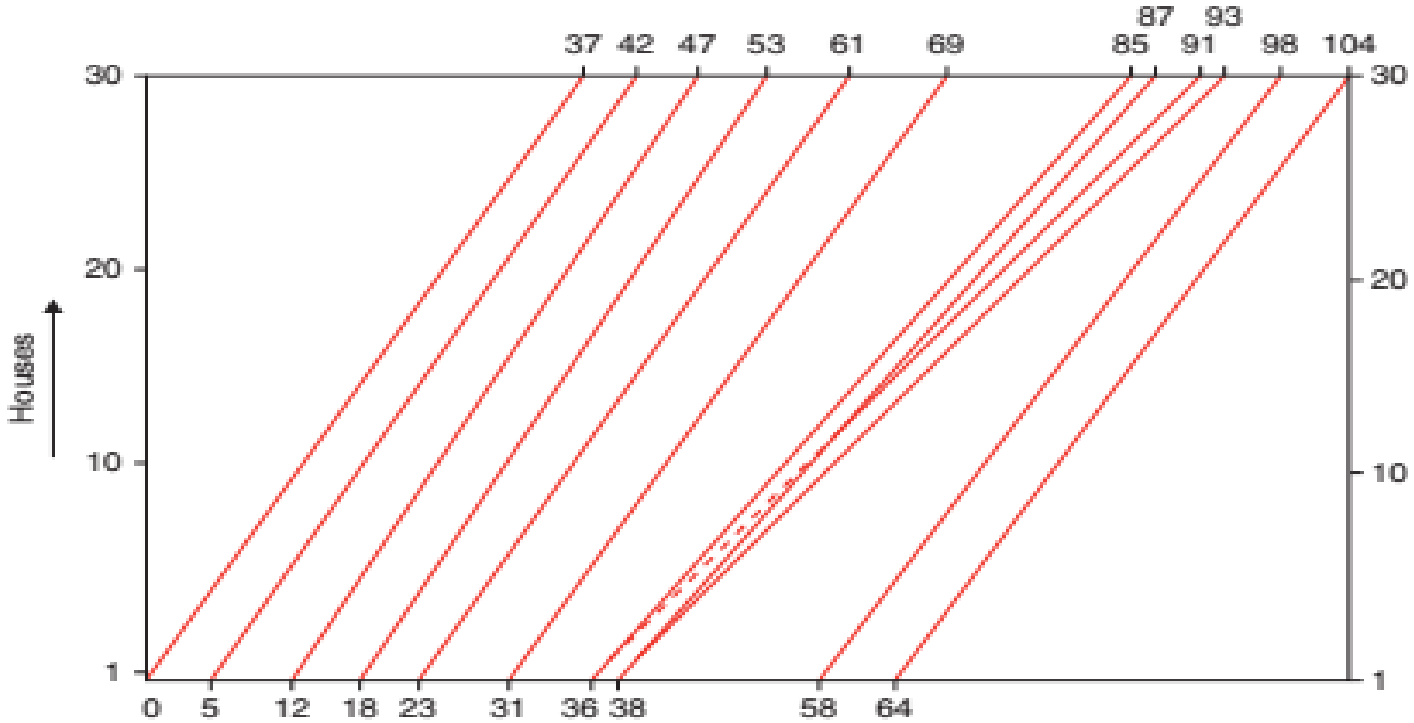
Example Two

Draw a LoB diagram for constructing 30 houses. The target rate for completion of these houses is four houses per week. A working week comprises five 8-h days and 5 days per week. It is assumed that there is a minimum buffer time of 5 days between each activities. he Target Rate of Building is 4 houses per week.

Activity	IPA	Man Hour Per Unit	Men Per Gang
A		120	3
B	A	290	6
C	B	250	4
D	C	40	3
E	C	30	2
F	D,F	220	5

Solution

Activity	Man Hour Per Unit	Men Per Gang	Theoretical Gang Size at the Choosen Output Rate	Actual Gang Size	Actual Output Rate	Activity Duration For One Unit	Time from Start on Fist Unit to Start on Last Unit
A	120	3	12	12	4.00	5.0	36.25≈37
B	290	6	29	30	4.14	6.04≈6	35.04≈35
C	250	4	25	24	3.84	7.81≈8	37.76≈38
D	40	3	4	3	3.00	1.67≈2	48.33≈49
E	30	2	3	2	2.67	1.88≈2	54.38≈55
F	220	5	22	20	3.64	5.5≈6	39.88≈40



Thank You !