The Torn Shirts Incorporated – Analyze Simulated Data to Manage Telephone Orders

The owners of Torn Shirts Incorporated now realize that they are losing a large number of incoming calls. Ellen's father, an Operation Researcher, suggests using additional data generated by a computer simulation to evaluate other options. These options are designed to increase the number of calls that can be answered. A computer simulation uses the total average call rate and the average call duration to generate a random pattern of calls that is consistent with the averages. Assumptions are made as to the probability distribution that applies to call arrivals and call duration. The simulated data appear in the Record of Calls Received tables and include the time of incoming calls, the duration for answered calls and a potential duration for unanswered calls for each day of the week. These times include a tenths decimal place. This is consistent with the recording practice of telephone companies. Help TSI analyze the possible increase in the number of answered calls if a) they buy call waiting, which allows exactly one call to be placed on hold, or b) they install a second line and staff both phones.

Task 1: Complete the table "MONDAY's Call Data" for **One Line** (no call waiting) while answering numbers **1-5**.

1. What has to occur for a call to be answered? _____

2. Identify the missed calls and place the letter M in the column labeled "**M**" under "**One Line**" (no call waiting). Beginning with call number 9, determine and record under the column labeled "**End time**" the completion time of all answered calls.

3. Explain why calls are missed. _____
   _____

4. Should missed calls have a duration time? ____ Why or why not?
   _____
   _____

5. What is the total number of missed calls? _____

Task 2: Complete the table "MONDAY's Call Data" for **One Line (with call waiting)** while completing numbers **6 – 17**.

6. Look at the third call. At what time would it be answered? _____

7. Why would it not be answered immediately? _____
   _____

8. How long would the third call wait to be answered? _____
   (Record this waiting time in the column labeled "**Wait time**".)

9. Explain the end time, 701.1, for the third call. _____
   _____

10. Explain why none of the calls numbered 4 through 7 would be placed on call waiting.
    _____
    _____
    _____

11. For calls numbered 9 through 16, complete columns labeled, "**End time", "Wait Time",** and **"M"**.
    Hint: You will need to check the end time of two previous calls in order to determine whether or not a call would be missed.

12. Would the 9^{th} call at 723.4, be answered? ____ If so, when would it end? _____

13. How long would the 10^{th} caller have to wait? _____

14. Would the 11^{th} call be answered immediately, placed on call waiting or missed? _____
    Hint: *Refer to the end time of the 9^{th} call!*

15. If the 11th call were answered, at what time would the call end? _____

16. What is the total number of missed calls with **call waiting**? _____

17. Does ***TSI*** pick up any more calls using call waiting on Monday? ____
    Explain. _____

18. What is the total number of calls placed on **call waiting?** ___ What is the average time these callers waited? ____

19. Do you think callers would be willing to wait this long? _____

Task 3: Complete the table "MONDAY's Call Data" for **Two Phone Lines (no call waiting)** while completing numbers **20– 25**. Assume that line 2 will be used only when line 1 is busy.

20. Why would the end-time for the 3rd call not be the same for **One Phone Line (with call waiting)** and **Two Phone Lines (no call waiting)**?
    _____
    _____

21. Explain why a call could still be missed with two phone lines.
    _____
    _____

22. For calls numbered 9 through 16, complete columns labeled, "**End time1", "End time2",** and **"M"**.

23. How many calls would be answered on phone line 2? _____

24. Record the number of calls that could be answered for each of the three options.
    No call waiting ____ Call waiting _____ Two phone lines _____

25. Calculate and record the **total net revenue** excluding fixed costs for each of the three options.
    No call waiting $____ Call waiting $_____ Two phone lines $_____

26. The cost of call waiting is an additional $10 per week. The cost of a second business phone line is $15 per week. Which of the three options would you recommend to TSI? Why?
    _____
    _____
    _____

27. Let's focus on the two phone-line option. Will this option enable the three business partners to meet their goal of each partner earning $100 per week? Explain!
    _____
    _____

28. Why might the $100 goal for each partner change under the option of two phone lines?
    _____
    _____

29. Should TSI make this decision based on this Monday's data? _____ Explain why or why not.
    _____
    _____

MONDAY's Call Data

Directions: Record the time each call ended, if serviced.

Call #	Time of Call	Duration actual or potential (in minutes)	One Line (no call waiting) End time	M	One Line (with call waiting) End time	Wait Time	M	Two Lines (no call waiting) End time1*	End time2	M
1	609.9	1.3	611.2		611.2			611.2		
2	636.8	23.0	659.8		659.8			659.8		
3	638.2	1.3		*M*	***659.8+1.3=701.1***				639.5	
4	642.2	6.6		*M*			*M*		648.8	
5	645.3	2.2		*M*			*M*			*M*
6	659.0	12.1		*M*			*M*		711.1	
7	659.4	15.0		*M*			*M*			*M*
8	707.0	2.2	709.2		709.2			709.2		
9	723.4	12.9								
10	727.3	14.4								
11	745.3	8.3								
12	749.0	1.9								
13	750.1	2.7								
14	822.0	8.1								
15	830.9	1.8								
16	838.5	1.8								

Single Line Codes: End Time = completion time for calls Answered Immediately M = Missed Call

Call Waiting Codes: End Time = completion time for calls Answered Immediately M = Missed Call
Wait Time = waiting time for calls Experiencing Call Waiting, Eventually Answered

Two Lines Codes: End Time1 = completion time for calls Answered Immediately on Line #1
End Time2 = completion time for calls Answered Immediately on Line #2
*Default to Line #1 when both lines are open M = Missed Call