Torn Shirts Inc.: Using Data to Analyze a Business Problem

Torn Shirts Incorporated (TSI) specializes in silk-screened shirts ripped to order. Marlene, Ellen and Helen, three high school students, run the business. They have come up with a variety of sayings such as "I've been ripped off by _____." where the customer fills in the blank. These have made their shirts popular. The potential buying population is the 10,000 high school students in their local district.

TSI distributes a bimonthly flier announcing their latest hot items. The weekly fixed cost for marketing, telephone lines and the computer system averages $100. The net revenue per shirt is $6 excluding the weekly fixed cost.

1. How many shirts do they need to sell in a week to cover their fixed costs? _____

Each of the three partners would like to earn $100 in profit per week to make their participation in the business worthwhile.

2. How many shirts would they need to sell to achieve their profit goal and cover their costs? _____

The owners take orders Monday through Friday by telephone between the hours of 6 PM and 9 PM. Marlene and Ellen staff the phones on alternate nights of the week, while Helen is in charge of marketing and production. Some of their friends say when they call to place an order that they frequently get a busy signal and just hang up. Marlene and Ellen decided to track all calls for a typical week. For each call answered, they recorded the time of the call and the duration of each answered call.

The data for the week are contained in **Table 1**.

3. How many orders were taken during the week? _____

4. Find the total profit during the week. _____

5. Did they meet their profit goal? _____

They decide to compute some averages from the data.

6. Find the average number of calls per hour. **Note**: *Phones are manned 3 hours a night.* _____

7. Find the total time spent answering calls. _____

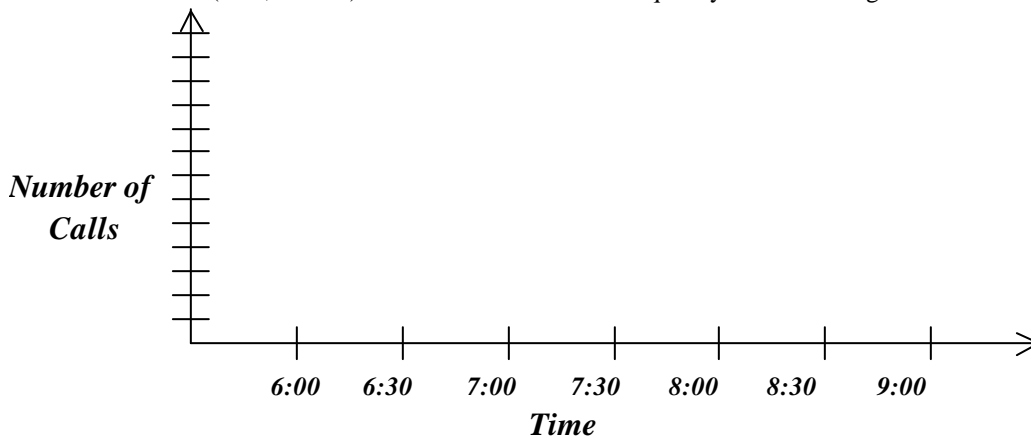8. Find the average duration of an answered call. _____

After finding the average duration of a call, Ellen realized there was a way to determine the probability that a caller gets a busy signal. If the calls are assumed to arrive totally at random, this probability is equal to the fraction of time that they are on the phone between 6 PM and 9 PM. Remember any time spent talking to a customer after 9 PM must be subtracted from the total number of minutes on the phone.

9. Determine the total number of minutes spent talking to a customer after 9 PM.   _____

10. What is the total number of minutes per week the line is staffed? _____

11. What is the probability, as a percent, of a caller getting a busy signal? _____

12. Explain the significance of the percent of time the phone is busy in terms of its impact on customer service.
    _____
    _____

13. If we assume that customers do not call back when they get a busy signal, what percent of their potential customers are they missing? _____

14. Use the answer to thirteen to find the percent of incoming calls that were answered (not lost). _____

15. Estimate the total number of calls during the week including those that were missed. _____

16. Use the information in items three and fifteen to estimate the number of calls that were missed and their potential revenue. _____ calls missed $ _____

Graphical Representation of Data

17. Make a histogram for the entire week of the number of answered calls in each half hour. The horizontal axis is in 30-minute intervals. (6:00, 6:30…). The vertical axis is the frequency of calls during each half hour.
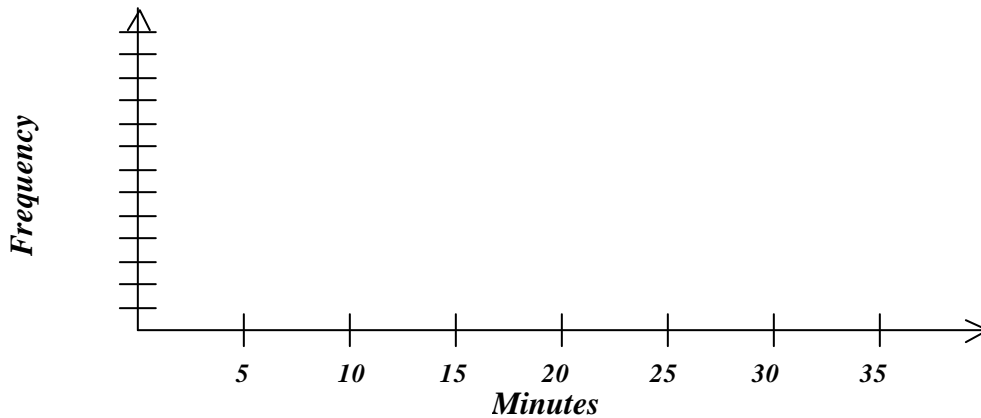
Number of Calls

6:00   6:30   7:00   7:30   8:00   8:30   9:00

Time

a)   Look for patterns in the histogram to describe its general shape.

_____
_____

b)   Based on the data, which is more likely?
   i)   a given call is received before 7:30.0,
   ii)   a given call is received after 7:30.0, or
   iii)   choice (i) is just as likely as choice (ii).

18. Make a histogram for the entire week of the time spent on each answered call. The horizontal axis represents the time spent on each answered call grouped in 5 minute intervals (0 to 5, 5.1 to 10, 10.1 to 15, …). The vertical axis is labeled frequency. It is the number of observations in each time interval.

Frequency

5   10   15   20   25   30   35

Minutes

a)   Look for patterns in the histogram to describe its general shape.

_____
_____

b)   Locate on the horizontal axis with a * the average duration of a call. (This was previously calculated in question 8.)

c)   Based on the data, which is more likely? _____
   i)   A given call is longer than the average call,
   ii)   A given call is shorter than the average call, or
   iii)   Choice (i) is just as likely as choice (ii).

d)   Place the duration of the 52 calls in order from the shortest length of 1.2 minutes to the longest length of 23 minutes. Find the median duration length.

e)   Based on the data, which is more likely?_____
      i)   A given call is longer than the median call,
      ii)   A given call is shorter than the median call,
      iii)   Choice (i) is just as likely as choice (ii).

f)   How are the mean and median related in a skewed-right distribution? _____
_____

News From the World of Operations Research

Red Cross Improves Blood Bank Operations	**AT&T Increases Market Share by $1B** **Call Processing Simulator Boosts Profits**	**Burger King Simulates Drive-Thru Traffic**
  Simulation Study Leads to Shorter Waits	AT&T reports that its Call Processing Simulator, a computer program used to analyze possible changes in the design and operation of call centers for customers, has helped it increase its share of the $8 billion service industry by $1 billion. The good news is not limited to AT&T alone. Industry sources estimate that AT&T's customers implementing the results of simulation studies increased their own profits by some $750 million.	 **Study Results Increase Profits $52 Million System-wide**

The Mathematics of Decision-Making in Industry and Government
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TABLE 1 - REGULAR Week - ANSWERED Calls

Monday			Thursday	
Time	**Duration**		**Time**	**Duration**
609.9	1.3		605.1	1.7
636.8	23.0		614.8	1.2
707.0	2.2		622.0	18.1
723.4	12.9		646.2	11.2
745.3	8.3		710.2	2.3
822.0	8.1		733.4	4.3
830.9	1.8		738.3	4.0
838.5	1.8		743.5	20.0
			806.9	1.2
			829.9	1.2

Tuesday			Friday	
Time	**Duration**		**Time**	**Duration**
600.3	4.1		601.4	7.3
617.4	1.5		624.4	9.8
636.6	4.8		639.7	3.6
654.9	2.9		645.7	4.5
703.6	12.6		653.9	15.7
721.2	2.8		735.2	1.4
726.6	4.0		748.3	2.3
730.9	12.6		750.9	1.7
812.2	7.6		809.1	7.8
828.7	19.6		823.7	7.6
856.2	3.1		851.2	15.1

Wednesday	
Time	**Duration**
611.8	7.6
622.1	9.1
631.3	3.5
652.4	1.7
657.7	16.2
714.2	1.5
718.5	4.7
724.5	4.2
729.7	11.0
819.1	5.4
830.3	4.3
852.9	2.9