**Solutions to**

**Case Problems**

**Chapter 2**

**Descriptive Statistics: Tabular and Graphical Displays**

**Case Problem 1: Pelican Stores**

1. There were 70 Promotional customers and 30 Regular customers. Because there are 100 observations in the sample, the frequency and percent frequency distribution are the same. Percent frequency distributions for many of the variables are given.

|  |  |
| --- | --- |
| No. of Items | Percent Frequency |
| 1 | 29 |
| 2 | 27 |
| 3 | 10 |
| 4 | 10 |
| 5 | 9 |
| 6 | 7 |
| 7 or more | 8 |
| Total: | 100 |

|  |  |
| --- | --- |
| Net Sales | Percent Frequency |
| 0.00 - 24.99 | 9 |
| 25.00 - 49.99 | 30 |
| 50.00 - 74.99 | 25 |
| 75.00 - 99.99 | 10 |
| 100.00 - 124.99 | 12 |
| 125.00 - 149.99 | 4 |
| 150.00 - 174.99 | 3 |
| 175.00 - 199.99 | 3 |
| 200 or more | 4 |
| Total: | 100 |

|  |  |
| --- | --- |
| Method of Payment | Percent Frequency |
| American Express | 2 |
| Discover | 4 |
| MasterCard | 14 |
| Proprietary Card | 70 |
| Visa | 10 |
| Total: | 100 |

|  |  |
| --- | --- |
| Gender | Percent Frequency |
| Female | 93 |
| Male | 7 |
| Total: | 100 |

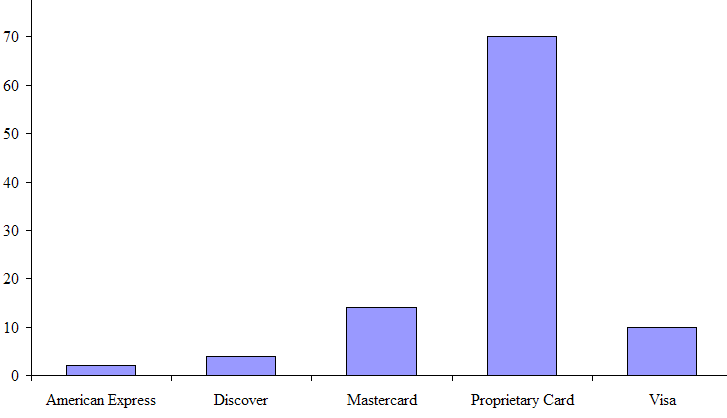
|  |  |
| --- | --- |
| Martial Status | Percent Frequency |
| Married | 84 |
| Single | 16 |
| Total: | 100 |

|  |  |
| --- | --- |
| Age | Percent Frequency |
| 20 - 29 | 10 |
| 30 - 39 | 30 |
| 40 - 49 | 33 |
| 50 - 59 | 16 |
| 60 - 69 | 7 |
| 70 - 79 | 4 |
| Total: | 100 |

These percent frequency distributions provide a profile of Pelican's customers. Many observations are possible, including:

* A large majority of the customers use National Clothing’s proprietary credit card.
* Over half of the customers purchase 1 or 2 items, but a few make numerous purchases.
* The percent frequency distribution of net sales shows that 61% of the customers spent $50 or more.
* Customers are distributed across all adult age groups.
* The overwhelming majority of customers are female.
* Most of the customers are married.

2.



3. A crosstabulation of type of customer versus net sales is shown.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Net Sales | | | | | | | | | | |  |
| Customer | 0-  25 | 25-  50 | 50-  75 | 75-  100 | 100-  125 | 125-  175 | 175-  200 | 200-  225 | 225-  250 | 250-  275 | 275-  300 | Total |
| Promotional | 7 | 17 | 17 | 8 | 9 | 3 | 2 | 3 | 1 | 2 | 1 | 70 |
| Regular | 2 | 13 | 8 | 2 | 3 | 1 | 1 |  |  |  |  | 30 |
| Total | 9 | 30 | 25 | 10 | 12 | 4 | 3 | 3 | 1 | 2 | 1 | 100 |

From the crosstabulation it appears that net sales are larger for promotional customers.

4. A scatter diagram of net Sales vs. age is shown below. A trendline has been fitted to the data. From this, it appears that there is no relationship between net sales and age.

Age is not a factor in determining net sales.

**Case Problem 2: The Motion Picture Industry**

This case provides the student with the opportunity to use tabular and graphical presentations to analyze data from the motion picture industry. Developing and interpreting frequency distributions, percent frequency distributions and scatter diagrams are emphasized. The interpretations and insights can be quite varied. We illustrate some below.

**Frequency Distribution and Percent Frequency Distribution**

The choice of the classes for frequency distributions or percent frequency distributions can be expected to vary. The frequency distributions we developed are as follows:

|  |  |
| --- | --- |
| **Opening Gross Sales (millions)** | **Frequency (or percentage)** |
| 0-9.99 | 11 |
| 10-19.99 | 44 |
| 20-29.99 | 17 |
| 30-39.99 | 14 |
| 40-49.99 | 1 |
| 50-59.99 | 4 |
| 60-69.99 | 3 |
| 70-79.99 | 0 |
| 80-89.99 | 2 |
| 90-99.99 | 2 |
| 100-109.99 | 0 |
| 110-119.99 | 0 |
| 120-129.99 | 0 |
| 130-139.99 | 1 |
| 140-149.99 | 0 |
| 150-159.99 | 0 |
| 160-169.99 | 1 |
| More | 0 |
| Toal | 100 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Gross Sales**  **(Millions)** | | | **Frequency** |
| $0 | – | 49.99 | 33 |
| 50 | – | 99.99 | 37 |
| 100 | – | 149.99 | 15 |
| 150 | – | 199.99 | 8 |
| 200 | – | 249.99 | 3 |
| 250 | – | 299.99 | 2 |
| 300 | – | 349.99 | 0 |
| 350 | – | 399.99 | 2 |
| Total | | | 100 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Number**  **of Theaters** | | | **Frequency** |
| 0 | – | 499 | 0 |
| 500 | – | 999 | 0 |
| 1000 | – | 1499 | 2 |
| 1500 | – | 1999 | 3 |
| 2000 | – | 2499 | 8 |
| 2500 | – | 2999 | 27 |
| 3000 | – | 3499 | 32 |
| 3500 | – | 3999 | 23 |
| 4000 | – | 4499 | 5 |
| Total | | | 100 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Weeks**  **in Release** | | | **Frequency** |
| 0 | – | 4 | 0 |
| 5 | – | 9 | 14 |
| 10 | – | 14 | 36 |
| 15 | – | 19 | 42 |
| 20 | – | 24 | 5 |
| 25 | – | 29 | 1 |
| 30 | – | 34 | 1 |
| 35 | – | 39 | 0 |
| 40 | – | 44 | 1 |
| Total | | | 100 |

**Histograms**

The following histograms are based on the frequency distributions shown above.

**Interpretation**

**Opening Weekend Gross Sales.** The distribution is skewed to the right with relatively few motion pictures having opening weekend gross sales of at least $40 million (14%), and only 2% had opening weekend gross sales of $100 million or more. Relatively few motion pictures had opening weekend gross sales less than $10 million. 75% of the motion pictures had opening weekend gross sales between $10 million and $40 million, and the vast majority of those motion pictures (44 out of 75) had opening weekend gross sales between $10 million and $20 million. Unless there is something unusually attractive about the motion picture, an opening weekend gross sales between $10 million and $40 million appears typical.

**Total Gross Sales.** This distribution is also skewed to the right, with 70% of the motion pictures having total gross sales less than $100 million and 85% less than $150 million. Highly successful blockbuster motion pictures are rare. Total gross sales over $200 million occurred only 7% of the time and over $350 million occurred only 2% of the time. No motion picture reported $400 million in total gross sales. Unless there is something unusually attractive about the motion picture, a total gross sales less than $100 million appears typical.

**Number of Theaters.** This distribution is skewed to the left. The number of theaters range from less than 500 to almost 4500. 82% of these motion pictures had extensive market exposure with the number of theaters between 2500 and 4000. As would be expected for these motion pictures, and small percentage (5%) appeared in fewer than 2000 theaters. 2500 to 4000 theaters is typical for these motion pictures.

**Weeks in Release.** This distribution is skewed to the right. Each of these motion pictures spent at least 5 weeks in release, with most (86%) in release for 10 or more weeks. Very few of these motion pictures (8%) lasted at least twenty weeks in release, and only one was in release for more than forty weeks.

**General Observations**. The data show that although many of these motion pictures had moderate opening weekend gross sales, most were in distribution in many theaters over several weeks and earned a relatively high total gross sales. It appears that many of the most successful films for this year were able to succeed without a big opening weekend at the box office.

**Scatter Diagrams**

Three scatter diagrams are suggested to show how Total Gross Sales is related to each of the other three variables.

**Interpretation**

**Opening Weekend Gross Sales.** The scatter plot of total gross sales and opening weekend gross sales shows a strong positive relationship. Motion pictures with the highest total gross sales were generally the motion pictures with the highest opening weekend gross sales. How the motion picture does during its opening weekend should be a very good predictor of how the motion picture will do in terms of total gross sales. Note in the scatter diagram that the majority of the motion pictures show a low opening weekend gross sales and a low total gross sales.

**Number of Theaters.** The scatter plot of the total gross sales and number of theaters also shows a positive nonlinear relationship. The relationship between total gross sales and the number of theaters for motion pictures playing in less than 3000 theaters is flat, but for motion pictures playing in more than 3000 theaters the relationship between total gross sales and the number of theaters is positive and relatively steep. Perhaps blockbuster motion pictures playing in over 4000 theaters have neared the maximum number of theaters in which they can play, and at that point the number of people who attend per showing increases to accommodate the large number of people who want to see a blockbuster film.

**Weeks in Release.** The scatter plot of the total gross sales and weeks in release shows a positive relationship, but this relationship appears to be the weakest of the three relationships studied. Generally, the higher gross sales motion pictures are in release for the highest number of weeks. However, this is not always the case. The five motion pictures with the highest total gross sales were in release less than 20 weeks. At the same time, three of the six motion pictures with over 20 weeks in release had total gross sales of less than $100 million. This suggests that in some cases blockbuster movies with high gross sales may run their course quickly and not have an excessively long release. At the same time, perhaps quality motion pictures with a limited audience may not generate the high total gross sales but may still be in release for more than 20 weeks. The number of weeks in release does not appear to the best predictor of total gross sales.

**Case Problem 3: Queen City**

This case provides the student with the opportunity to use basic tabular and graphical presentations to describe data from the annual expenditures for the city of Cincinnati, Ohio. The data set is large relative to others in the text. It contains 5,427 records of expenditures. As such, one point of this case is to expose students to a larger data set and help them understand that the pivot tables and charts can be used on a larger data set. In some cases, the student will have to copy, paste, and aggregate data to create the desired tables and charts. Style of presentation may vary by student (for example, vertical versus horizontal bar charts may be used). We illustrate with results and comments below.

**Expenditures by Category**

The pivot table shows expenditures and percentage of total expenditures by category. The bar chart shows percentage of total expenditures by category (both the table and the bar chart are sorted in descending order). Capital expenditures and payroll account for over 50% of all expenditures. Total expenditures are over $660 million. Debt Service seems somewhat high, as it is over 10% of total expenditures.

|  |  |  |
| --- | --- | --- |
| **Category** | **Total Expenditures** | **% of Total Expenditures** |
| Capital | $198,365,854 | 29.98% |
| Payroll | $145,017,555 | 21.92% |
| Debt Service | $86,913,978 | 13.14% |
| Contractual Services | $85,043,249 | 12.85% |
| Fringe Benefits | $66,053,340 | 9.98% |
| Fixed Costs | $53,732,177 | 8.12% |
| Materials and Supplies | $19,934,710 | 3.01% |
| Inventory | $6,393,394 | 0.97% |
| Payables | $180,435 | 0.03% |
| Grand Total | $661,634,693 | 100.0% |

**Expenditures by Department**

The following table and bar chart show the percentages of total expenditures incurred by department. Note that we have combined all departments that individually incurred less than 1% of the total expenditures. There are 119 departments, and 96 each account for less than 1% of the total expenditures. As shown below, only six individual departments incur 5% or more of the total expenditures. These include, Police, Sewers, Transportation Engineering (Engineering). Fire, Sewer Debt Service and Finance/Risk Management. Debt service on sewers as a percentage of total expenditures appears to be very high.

|  |  |
| --- | --- |
| **Department** | **% of Total Expenditures** |
| Department of Police | 9.7% |
| Department of Sewers | 8.8% |
| Transportation and Engineering, (Engineering) | 8.7% |
| Department of Fire | 7.2% |
| Sewers, Debt Service | 6.6% |
| Finance, Risk Management | 5.4% |
| SORTA Operations | 3.6% |
| Water Works, Debt Service | 3.2% |
| Department of water Works | 3.1% |
| Finance, Treasury | 2.8% |
| Economic Development | 2.1% |
| Division of Parking Services | 1.9% |
| Community Development, Housing | 1.7% |
| Enterprise Technology Solutions | 1.7% |
| Public Services, Fleet Services | 1.7% |
| Finance, Accounts & Audits | 1.7% |
| Transportation and Engineering, Planning | 1.6% |
| Public Services, Neighborhood Operations | 1.4% |
| Sewers, Millcreek | 1.3% |
| Health, Primary Health Care Centers | 1.2% |
| Water Works, Water Supply | 1.2% |
| Public Services, Facilities Management | 1.1% |
| Sewers, Wastewater Administration | 1.0% |
| Other Depts. (< 1% each) | 21.2% |
| Total | 100.0% |

**Expenditures by Fund**

The following bar table and bar chart show the percentages of total expenditures charged by fund used to pay. Note that we have combined those funds that each cover less than 1% of the total expenditures. There are 129 funds in the data base, and 117 of these funds each account for less than 1% of total expenditures.

|  |  |
| --- | --- |
| **Fund** | **% of Total Expenditures Covered** |
| 050 - GENERAL FUND | 25.5% |
| 980 - CAPITAL PROJECTS | 16.0% |
| 701 - METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI | 12.7% |
| 704 - METROPOLITAN SEWER DISTRICT CAPITAL IMPROVEMENTS | 8.8% |
| 101 - WATER WORKS | 7.9% |
| 711 - RISK MANAGEMENT | 4.9% |
| 759 - INCOME TAX – TRANSIT | 3.7% |
| 151 - BOND RETIREMENT – CITY | 2.4% |
| 202 - FLEET SERVICES | 1.7% |
| 898 - WATER WORKS IMPROVEMENT 12 | 1.3% |
| 897 - WATER WORKS IMPROVEMENT 11 | 1.3% |
| 302 - INCOME TAX – INFRASTRUCTURE | 1.1% |
| Other (< 1 % each). | 12.9% |
| Total | 100.0% |

**Other Points:** There are 5,427 records of expenditures in the data base, of which 235 (4.3%) are negative.

**Case Problem 4: Cut-Rate Machining, Inc.**

A scatter diagram of the results for Hole-Maker in the order the holes were drilled shows that this machine consistently overdrills and is moderately consistent.

A scatter diagram of the results for Shafts & Slips in the order the holes were drilled shows that this machine consistently underdrills and is moderately consistent.

A scatter diagram of the results for Judge’s Jigs in the order the holes were drilled shows that on average this machine this machine consistently underdrills and is extremely consistent.

A scatter diagram of the results for Drill-for-Bits in the order the holes were drilled shows that an average diameter of approximately 3 centimeters. However, machine this machine is very inconsistent.

If we focus solely on the average performance of a drill, we would purchase Drill-for-Bits as the diameters of holes drilled by this vendor’s drill appear to be centered at approximately 3 centimeters. However, the diameters of the holes drilled by Drill-for-Bits’ machine are extremely inconsistent – several are over ½ centimeter too wide and several are over ½ centimeter to narrow.

The diameters of holes drilled by the machine provided by Hole Maker are more consistent than those drilled by the machine provided by Drill-for-Bits, and this machine did not drill a single hole that is too narrow. If holes that are slightly too wide are acceptable, we should consider purchasing our drill from Hole Maker.

The diameters of holes drilled by the machine provided by Shafts & Slips are similar in consistency to the holes by the machine provided by Hole Maker, and this machine did not drill a single hole that is too wide. If holes that are slightly too small are acceptable, we should consider purchasing our drill from Shafts & Slips.

The diameters of holes drilled by the machine provided by Judge’s Jigs are far more consistent than holes by the machine provided any of the other vendors, but these holes are far too narrow. We should determine if this drill can be recalibrated to that the mean size of holes drilled is approximately 3 centimeters. If this can be done, we should consider purchasing our drill from Judge’s Jigs and recalibrating the drill; this would give us a machine that consistently drills holes of approximately 3 centimeters.

However, before we make a decision we should scrutinize the way that these data were collected. We were told that Weideman started all four machines at 8:00 a.m. and let them warm up for two hours. We also see from the data that the drill provided by Hole-Maker was tested from 10:00 a.m. to noon, the drill provided by Shafts & Slips, Inc. was tested from noon to 2:00 p.m., the drill provided by Judge’s Jigs was tested from 2:00 p.m. to 4:00 p.m., and the drill provided by Drill-for-Bits was tested from 4:00 p.m. to 6:00 p.m. Were all drills allowed to keep running after the 8:00 a.m. – 10:00 a.m. warm-up period? Either way, this could bias the results.

We also see from the data that Ms. Ames ran the test drills from 10:00 a.m. to 4:00 p.m. when the drills provided by Hole-Maker, Shafts & Slips, and Judge’s Jigs were tested. Mr. Silver ran the test drill from 4:00 p.m. to 6:00 p.m. when the drill provided by Drill-for- Bits was tested. If these two employees are not equally competent, this could bias the results. Furthermore, did Ms. Ames become fatigued as the day progressed? Did she take a break for lunch or take a break at any other time?

We also note that we only tested one drill for each vendor. If the drill provided by a vendor is not representative of the drills that vendor produced, this could bias the results.

The data for this test should have been collected through an experimental study in which the four machine were all warmed up for the same amount of time and then left running as eight holes were drilled by each employee using the drill provided by each vendor in a random order. A design such as this would have eliminated the potential sources of bias we have identified and resulted in the collection of more reliable data, which would lead to a superior decision.