

## Pareto Analysis in Forensic Investigations

Note: this document was excerpted from the [Audit Commander User Guide](#).

The Italian economist, Vilfredo Pareto, first postulated the “80/20” rule which has found wide applicability. His finding was that 20% of the persons in Italy accounted for 80% of the wealth. However, this finding has also found wide applicability in a number of areas, especially in auditing and forensic investigations. Testing for the applicability of the rule enables the auditor to focus on just the “key” areas.

Included in the Case Study is number 20 – “Hiker’s ‘R Us’”. This case study pertains to a fraud relating to customer refunds wherein insiders were able to obtain significant amounts of money through various schemes. In this case study, although there appeared to be adequate segregation of duties between the three primary areas – Call Center, Customer Service and Treasury. However, an analysis of the data disclosed otherwise.

There are two metrics which can be used for a Pareto analysis:

1. Analysis by transaction counts
2. Analysis by transaction totals

These two metrics can be developed using any of a number of methods:

1. Selection of a key field such as vendor number, employee number, store, location, etc.
2. Generation of a key field, based upon a transaction date, e.g.
  - a. Month
  - b. Year
  - c. Day of Week
  - d. Hour of Day

In the examples below, each of these techniques will be illustrated.

The data used for the examples shown is an excel work book named Customer Refund.xls”. This work book contains the examples for the Fraud case study – Hikers ‘R Us. The workbook contains multiple sheets, containing transactions for the Call Center, Customer Service, Treasury, etc. There are approximately 5,000 transactions which cover a period of three months.

### Summary

Pareto analysis can be a powerful tool for general use in auditing. It also has a variety of uses in forensic investigations.

### Example Analysis

The key fields for analysis are the employee numbers and the various dates such as call date, approval date, etc. A total of ten examples of Pareto Analysis will be shown:

- [Example 1 – Transaction Counts by Employee](#)
- [Example 2 – Refund Amounts Processed by Employee](#)
- [Example 3 – Transaction Counts by Month](#)
- [Example 4 – Refund Amounts by Month](#)
- [Example 5 – Transaction Counts by Day of Week](#)
- [Example 6 – Refund Amounts by Day of Week](#)
- [Example 7 – Transaction Counts by Year](#)
- [Example 8 – Refund Amounts by Year](#)
- [Example 9 – Transaction Counts by Hour of Day](#)
- [Example 10 – Refund Amounts by Hour of Day](#)

The input form is shown below:

The screenshot shows a software dialog box titled "Pareto analysis - month". The dialog has a blue title bar with standard window controls. The main area is light beige and contains several input fields and controls:

- File:** A text field with a dotted border.
- Table:** A dropdown menu.
- Where:** A text field with a "Where" button to its left.
- Key / Date:** A dropdown menu.
- Trans Amount:** A dropdown menu.
- Theme:** A dropdown menu.
- Title:** A text field containing "Test Pareto Chart".
- Analysis Type:** A group of radio buttons with "Month" selected. Other options are "Day of week", "Year", "Hour", and "Amount".
- Count / Sum:** A group of radio buttons with "Count" selected. Other option is "Sum".
- Run:** A button at the bottom right.
- Status:** A label at the bottom left.

## Use of Pareto Charts in Forensic Investigations

An explanation of the data elements in the form:

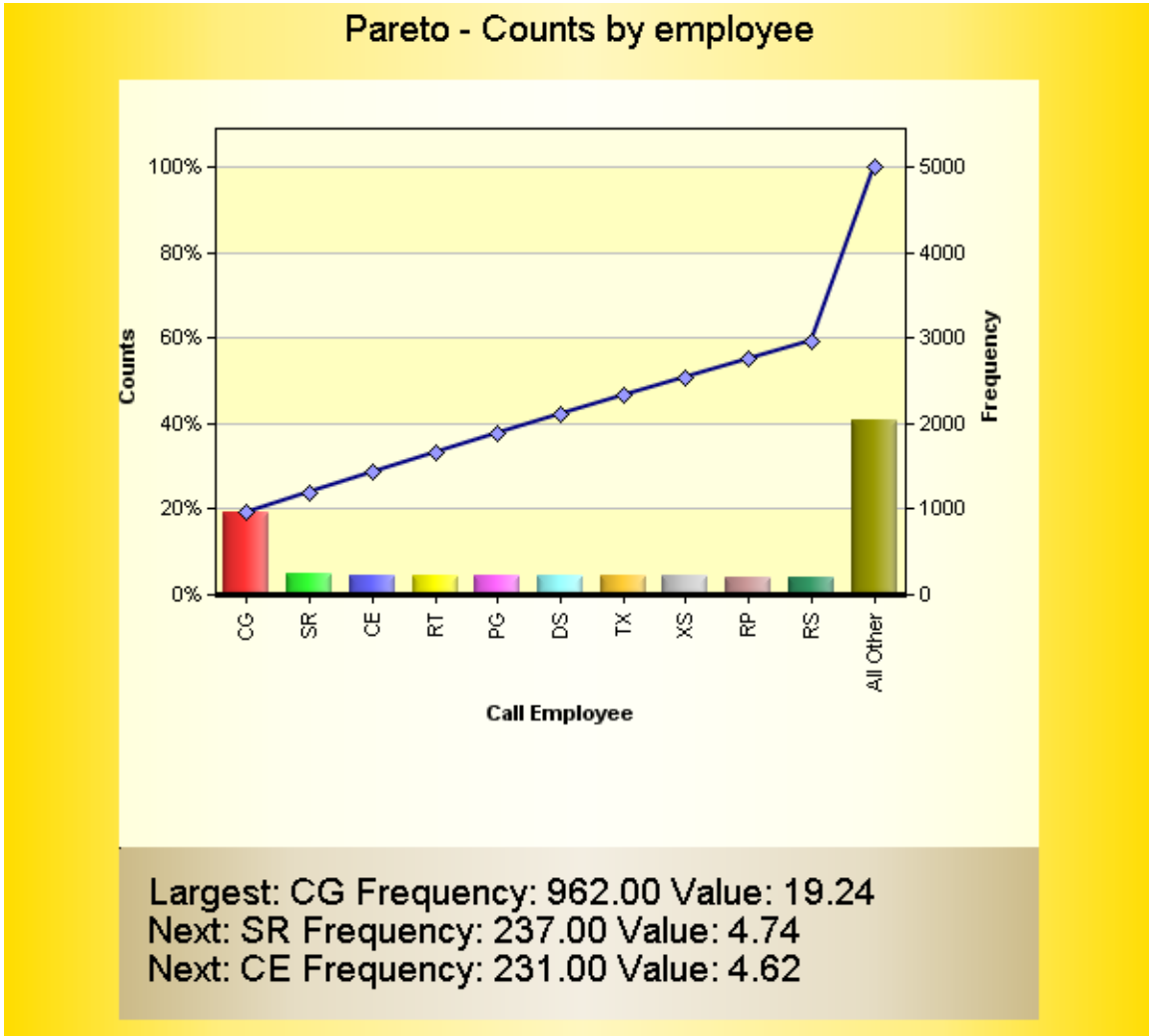
- **File** – The name of the data source containing the information to be analyzed (Can be Excel workbook, Access database or text file)
- **Table** – For Excel - the SheetName, For Access - the table, for Text - the file name
- **Where** – If only a subset of the data is to be reviewed, enter the criteria here
- **Key / date** – For analysis by key field, e.g. vendor, customer select the key field name, otherwise use the transaction date
- **Trans Amount** – The numeric amount to be tested
- **Theme** – (not currently used)
- **Title** – The title to be shown on the chart created
- **Analysis Type** – Key value, hour, day, month
- **Count / Sum** – Select either counts or totals

**Example 1 – Transaction Counts by Employee**

Input form

The screenshot shows a dialog box titled "Pareto analysis - amount". It has a blue title bar with standard window controls. The main area is light beige and contains several input fields and a "Run" button. On the left side, there are labels for "File", "Sheet", "Where", "Key / Date", "Trans Amount", "Theme", "Title", and "Status". The "File" field contains "C:\Test\Data\Customer Refund.xls". The "Sheet" field is a dropdown menu showing "'Call Center\$'". The "Key / Date" field is a dropdown menu showing "Call Employee". The "Trans Amount" field is a dropdown menu showing "Refund Amount". The "Title" field contains "Refund Counts by Employee". On the right side, there are two groups of radio buttons. The first group is labeled "Analysis Type" and includes options for "Month", "Day of week", "Year", "Hour", and "Amount", with "Amount" selected. The second group is labeled "Count / Sum" and includes options for "Count" and "Sum", with "Count" selected. A "Run" button is located at the bottom right of the dialog box.

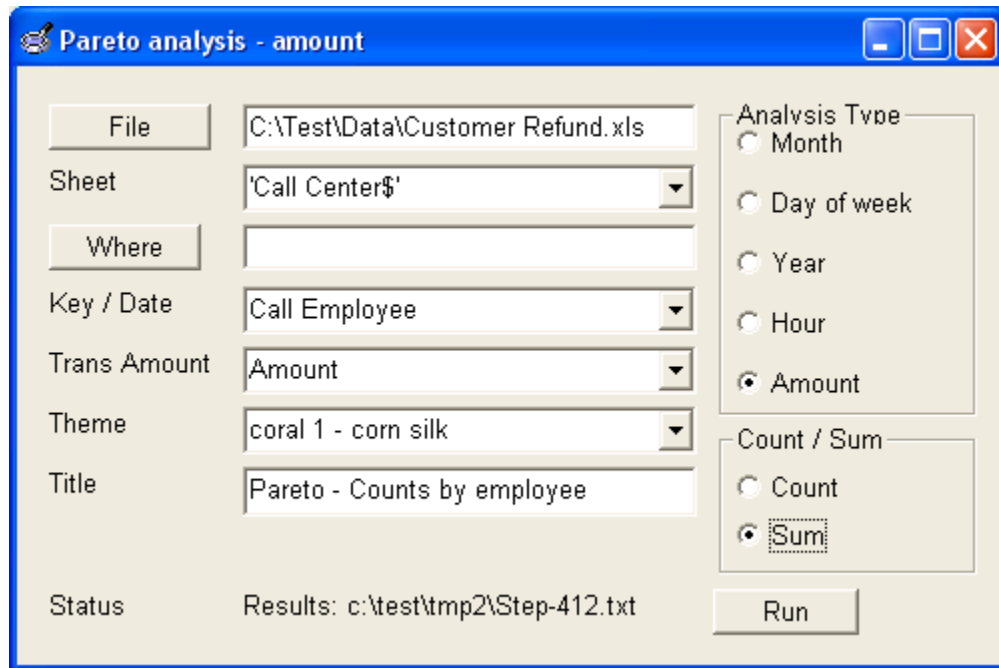
**Chart results**



**Conclusion**

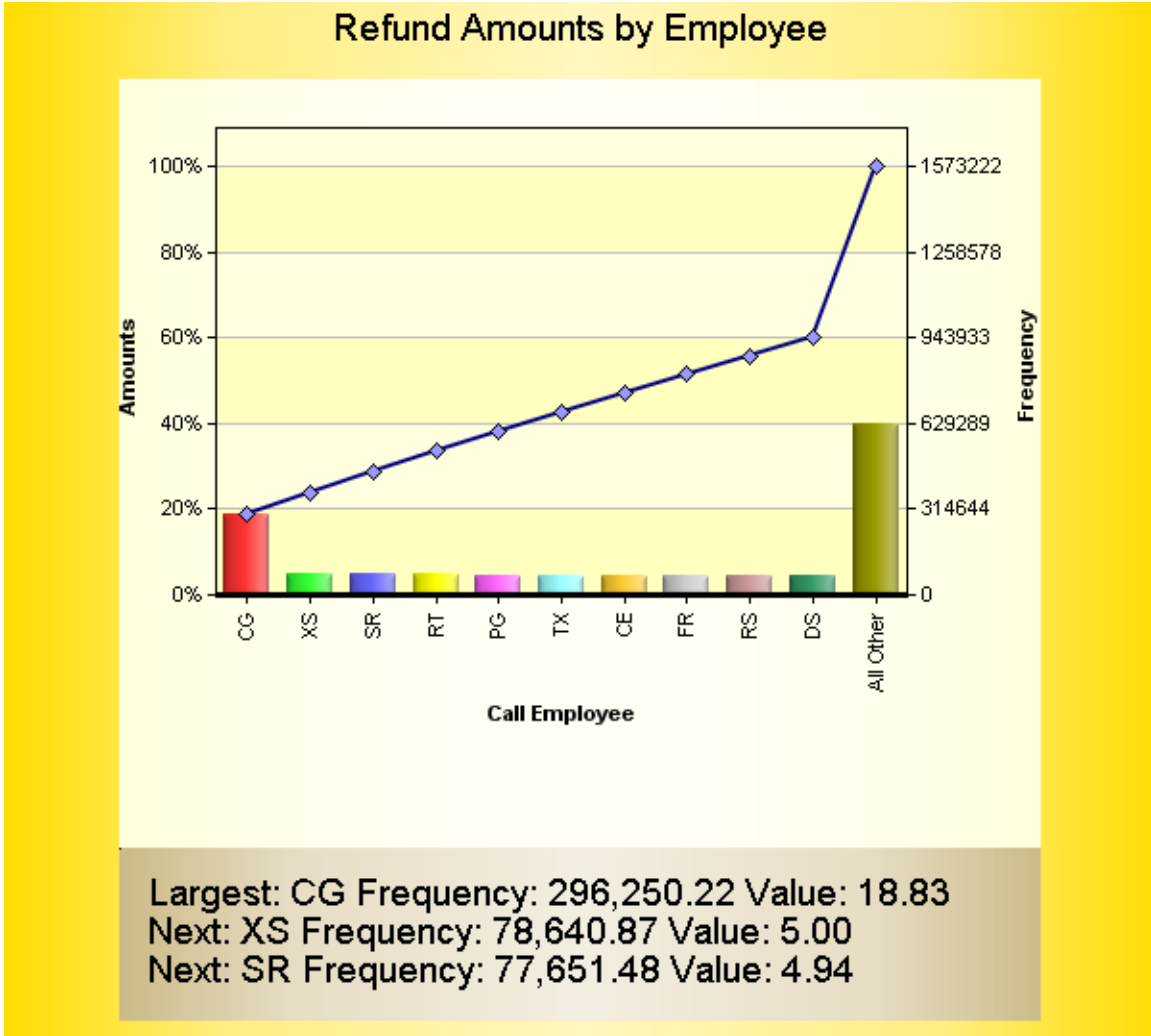
The employee with the largest counts is employee “CG” issued 962 refunds, and accounts for 19.24% of the total. Since the counts are supposed to be spread evenly between employees, this chart might raise some questions regarding the refunds issued by employee “CG”.

**Example 2 – Refund Amounts Processed by Employee**



Now let's see the dollar amounts involved (just click the "sum" radio button).

Chart results – example 2



**Conclusion**

Employee “CG” is also processing a substantial amount of refunds (\$296,250) which accounts for almost 19% of all refunds.

**Example 3 – Transaction Counts by Month**

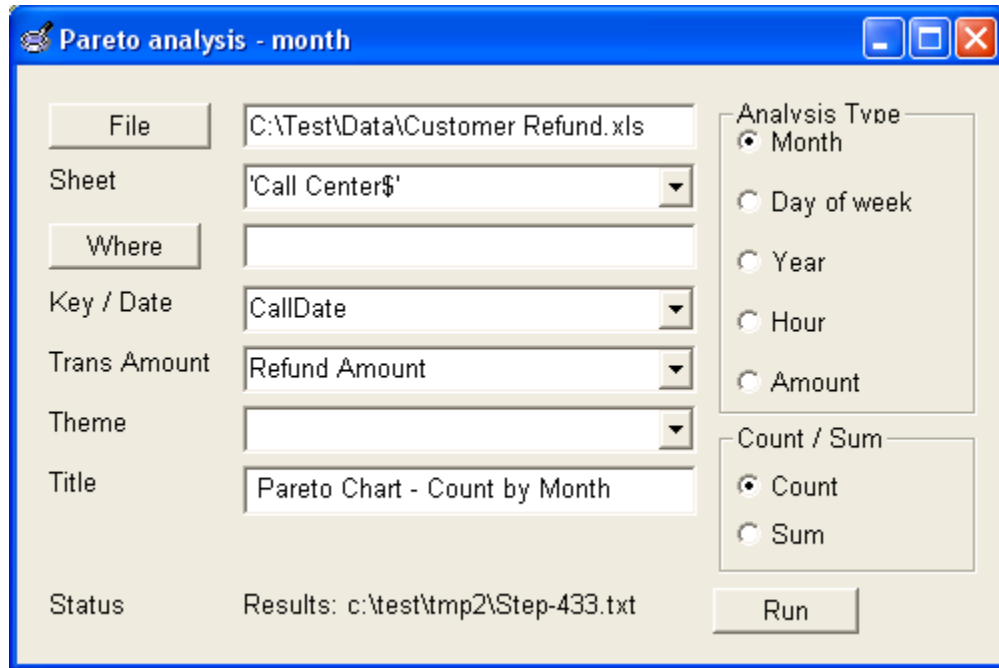
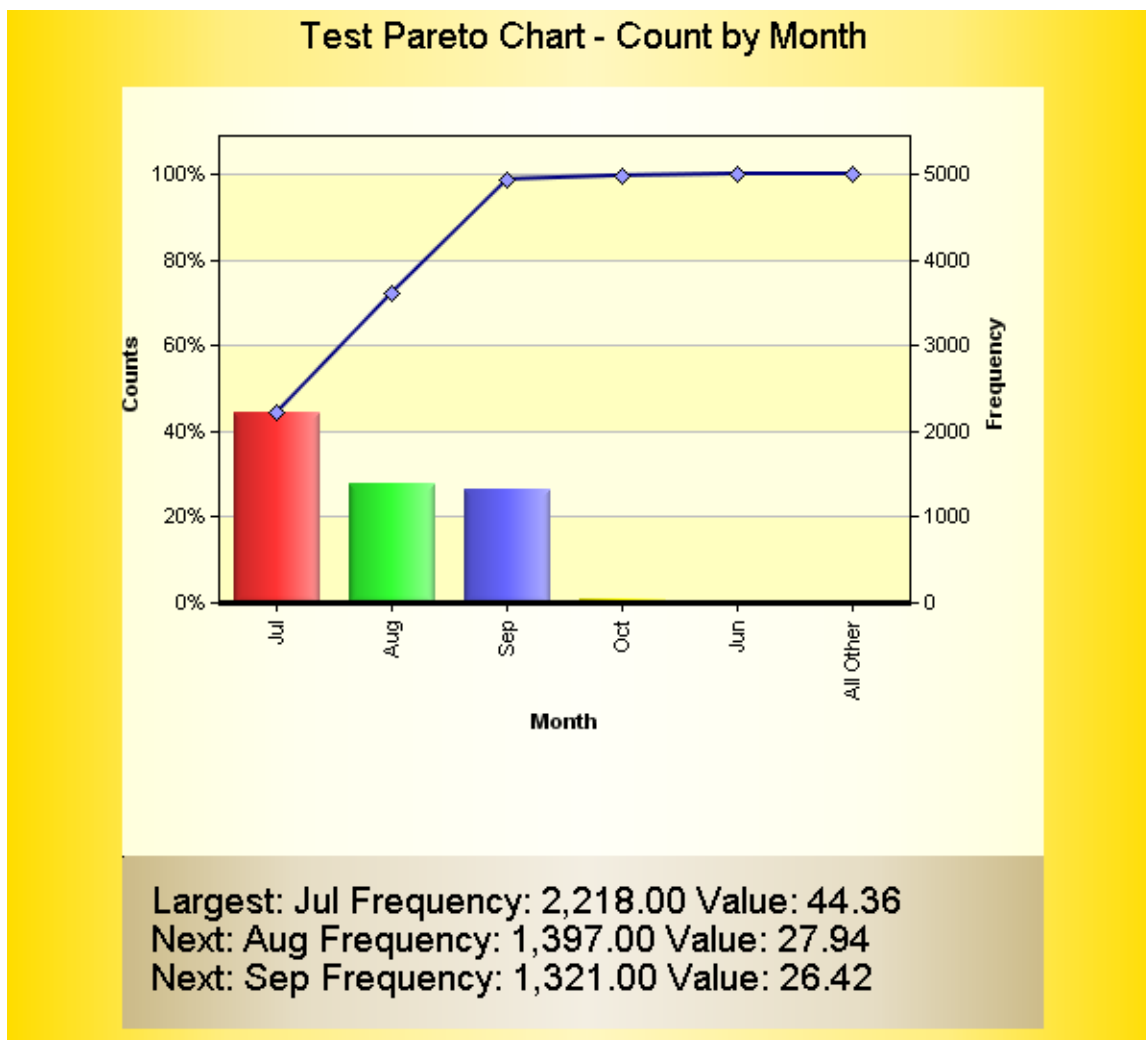


Chart results – example 3



Conclusion

July is the busiest month of the quarter, accounting for a little over 44% of the total counts.

**Example 4 – Refund Amounts by Month**

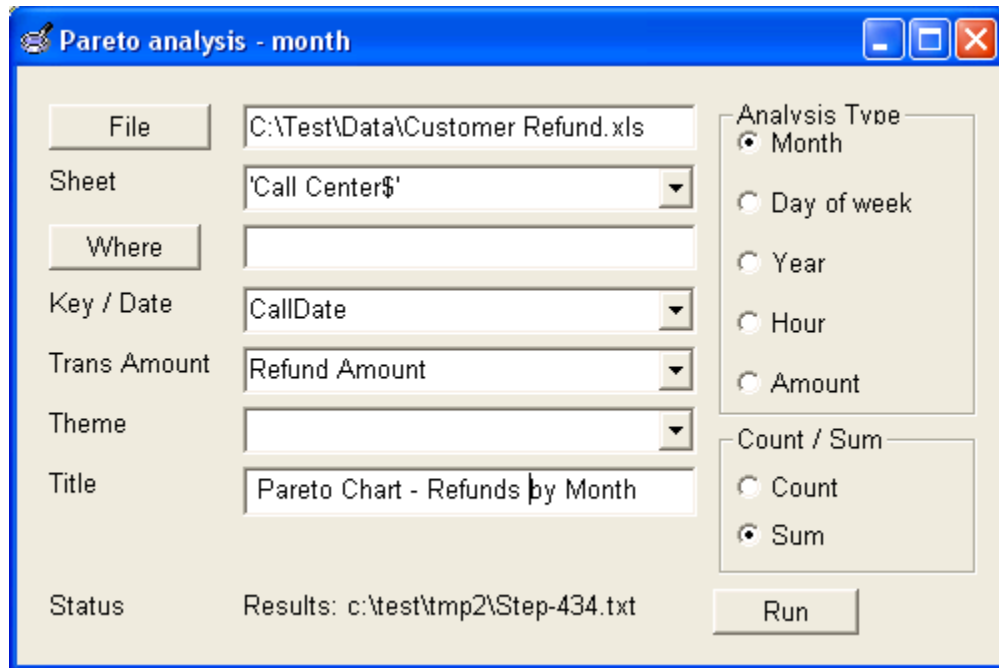
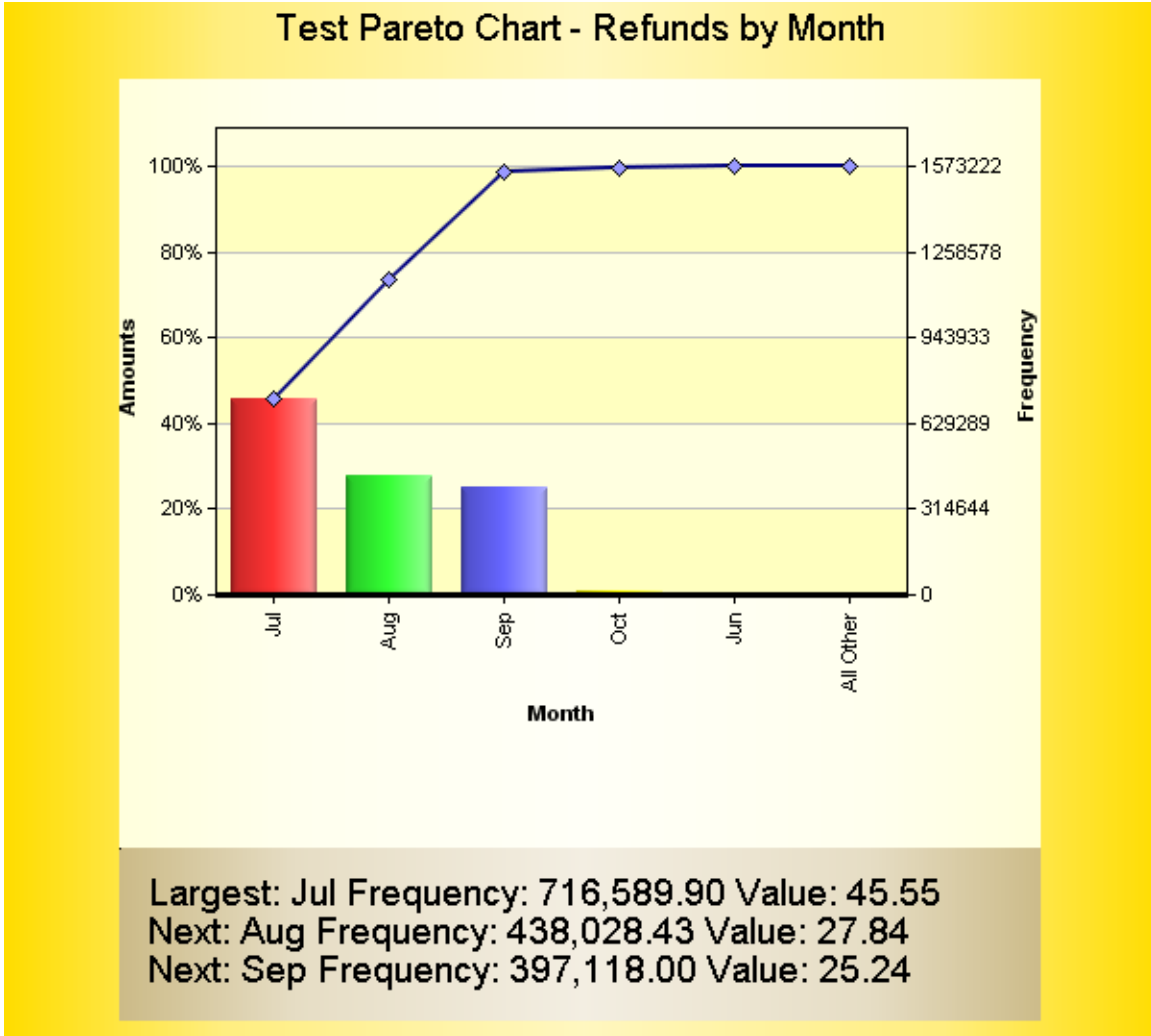


Chart results – example 4 Refund Amounts by Month



Since the information is just for one quarter, we don't expect to see any months other than July, August and September.

Example 5 – Transaction Counts by Day of Week

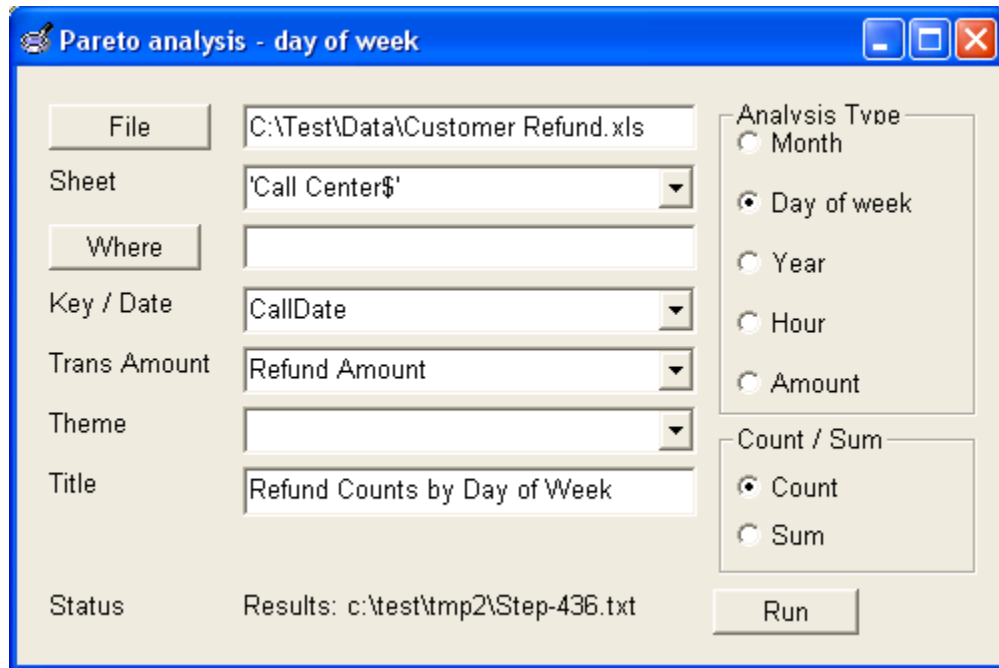
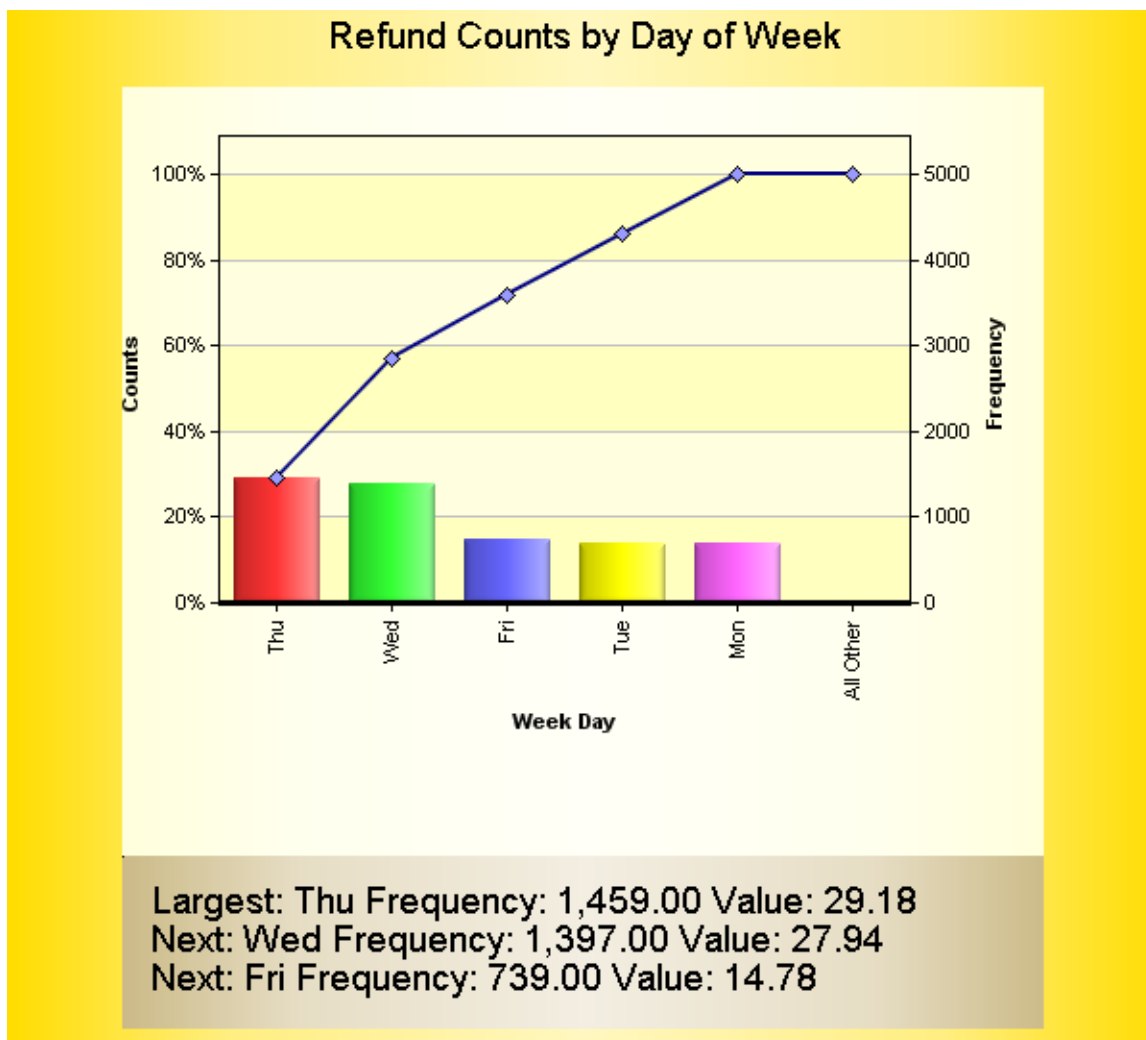


Chart results – example 5 – Refund counts by day of week



**Conclusion**

Most of the refunds made are on Wednesday and Thursday. Note that there are few or none on weekends (business is closed).

**Example 6 – Refund Amounts by Day of Week**

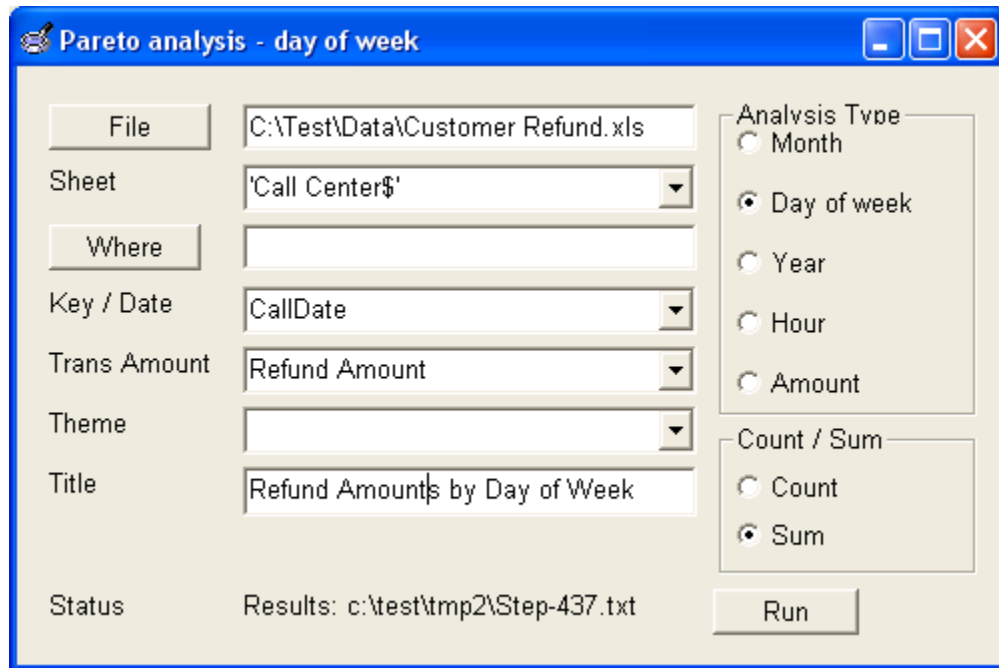
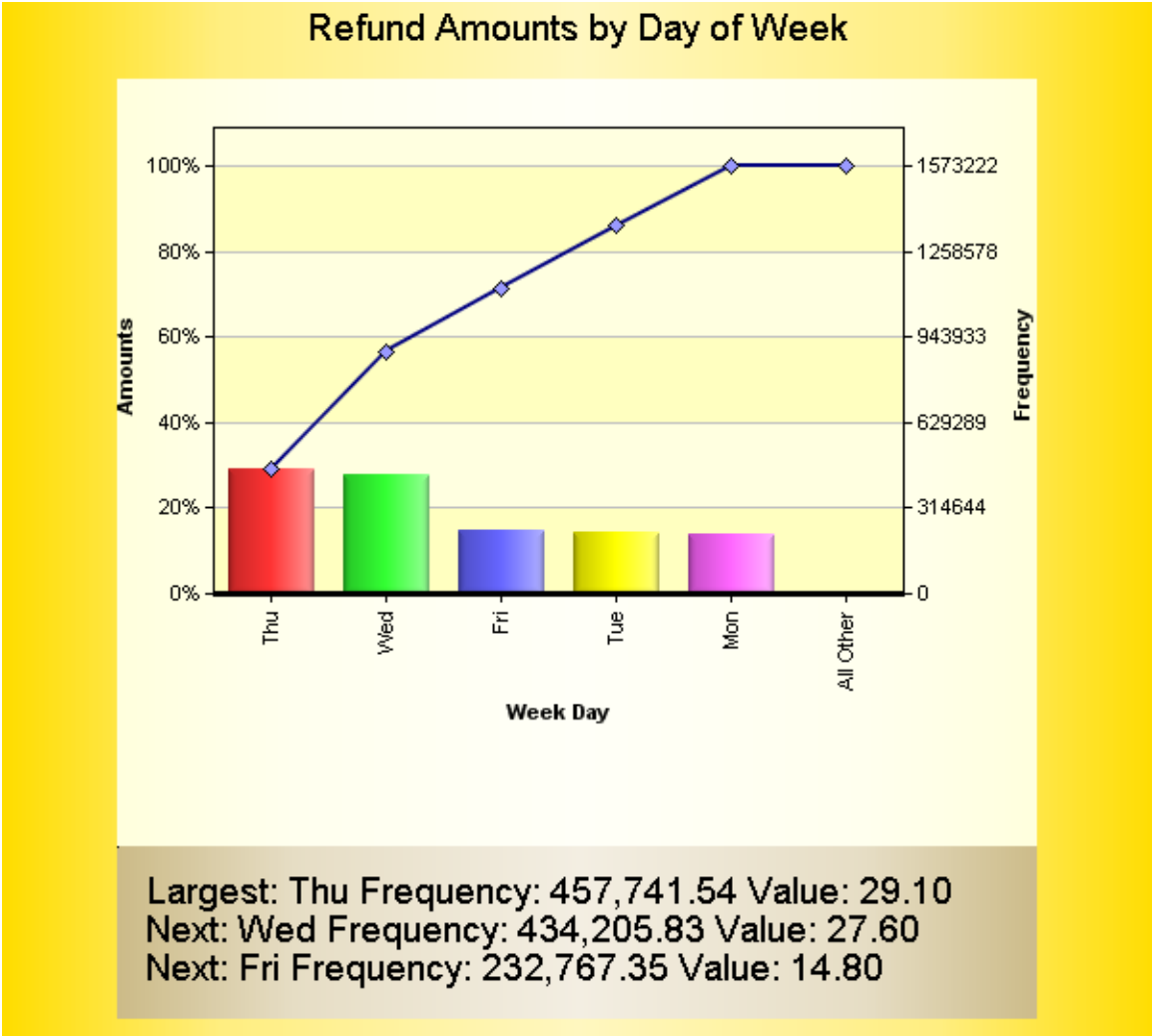


Chart results – example 6 – Refund amounts by day of week



Example 7 – Transaction Counts by Year

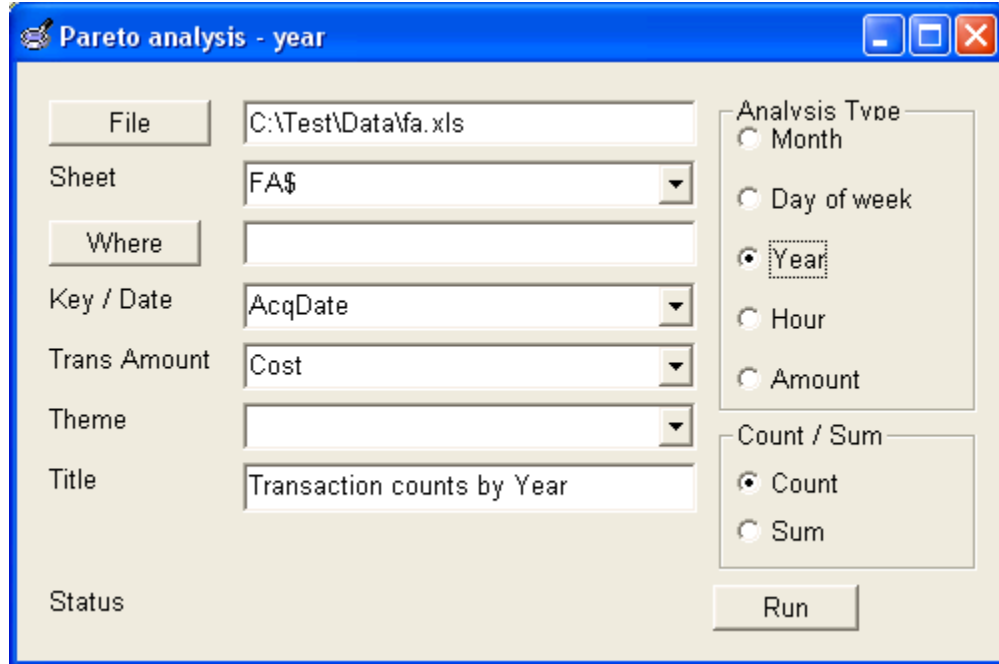
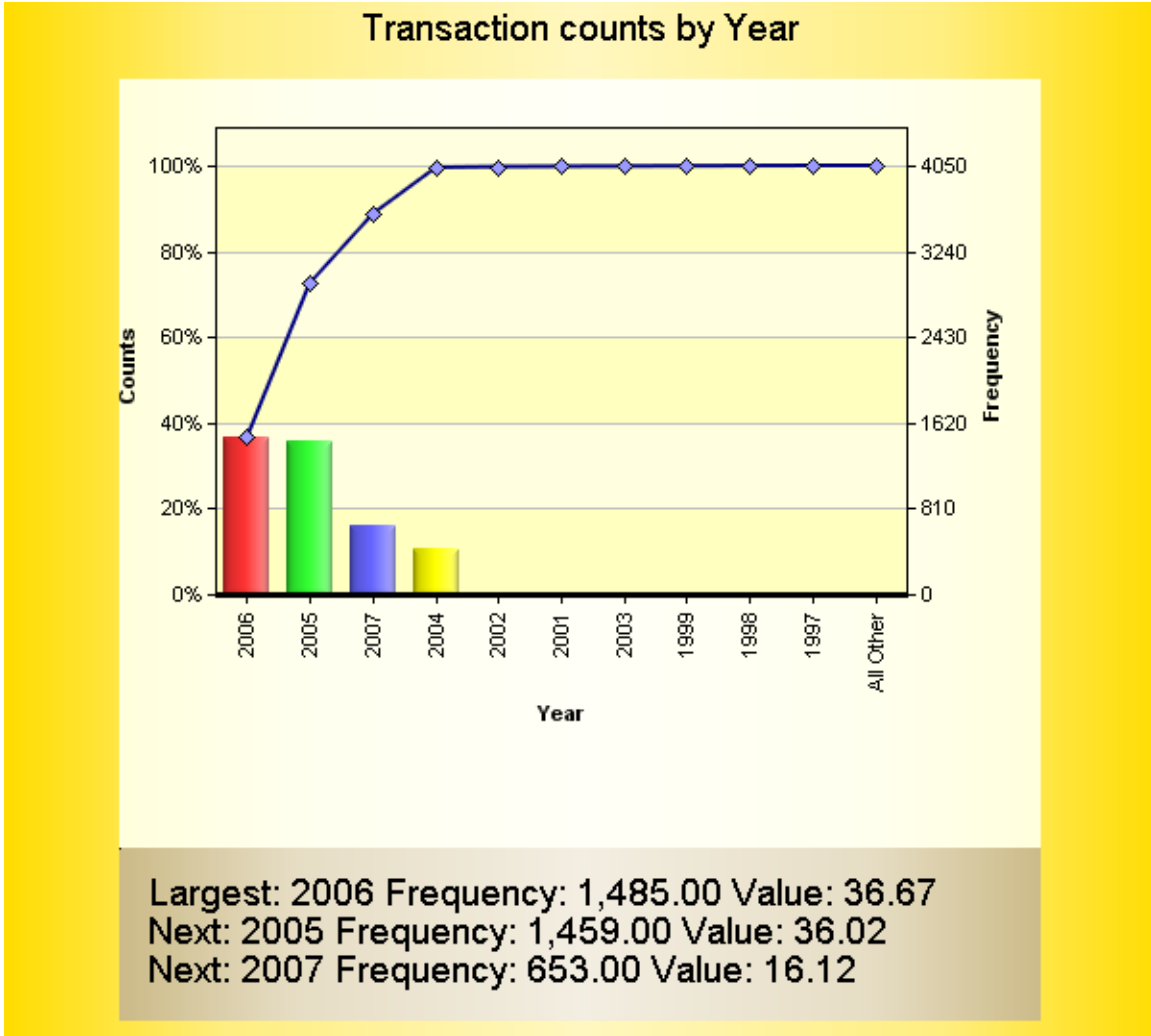


Chart results – example 7 (Transaction counts by Year)



Conclusion

Almost all of the transactions were in the years 2004 – 2007. Strangely, there were fewer transactions in 2007 than 2006.

Example 8 – Asset acquisition amounts by Year

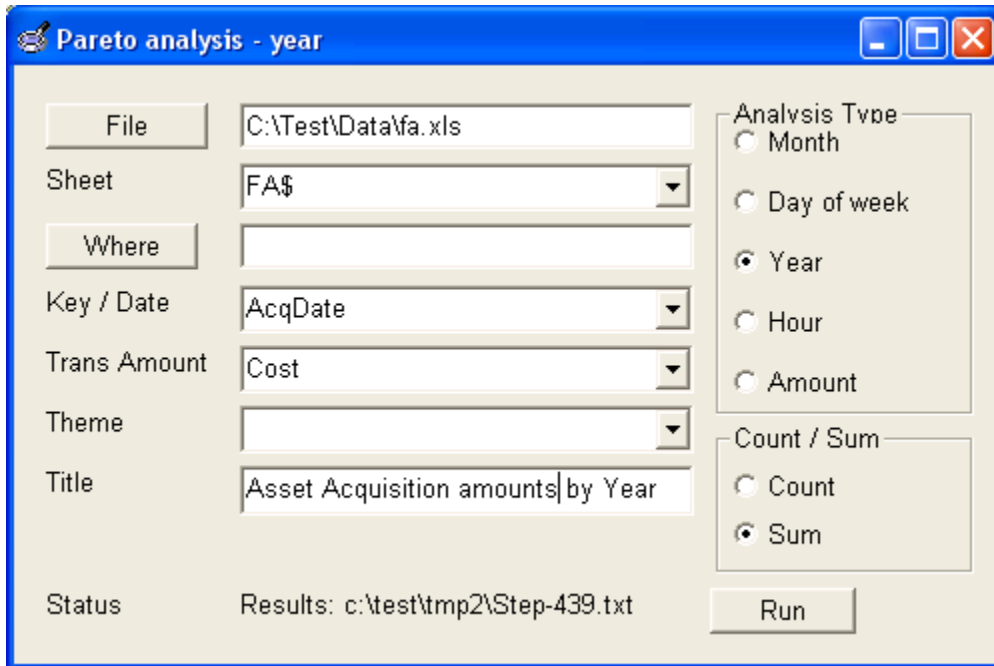
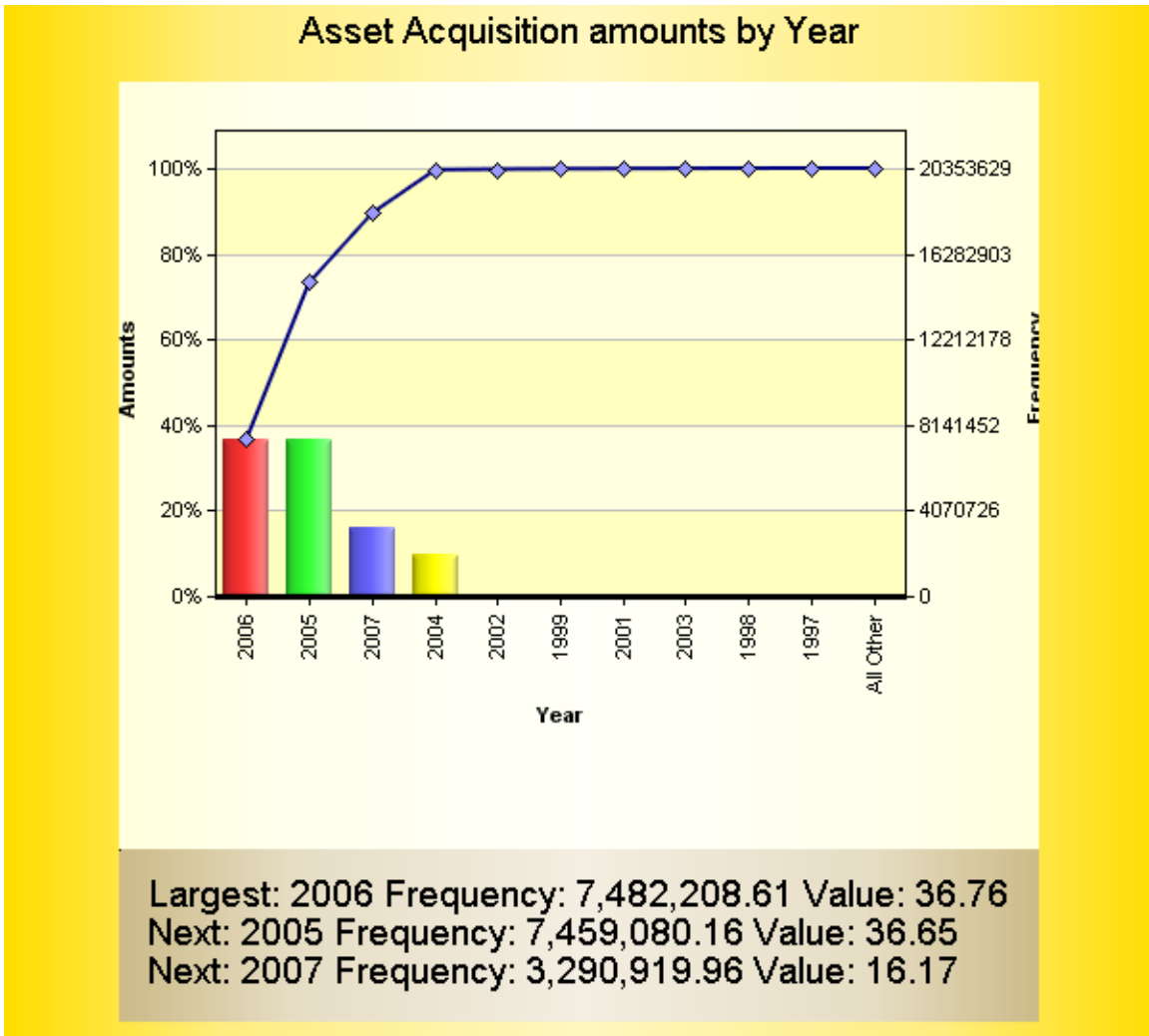


Chart 8 – Amounts by Year



Example 9 – Transaction Counts by Hour of Day

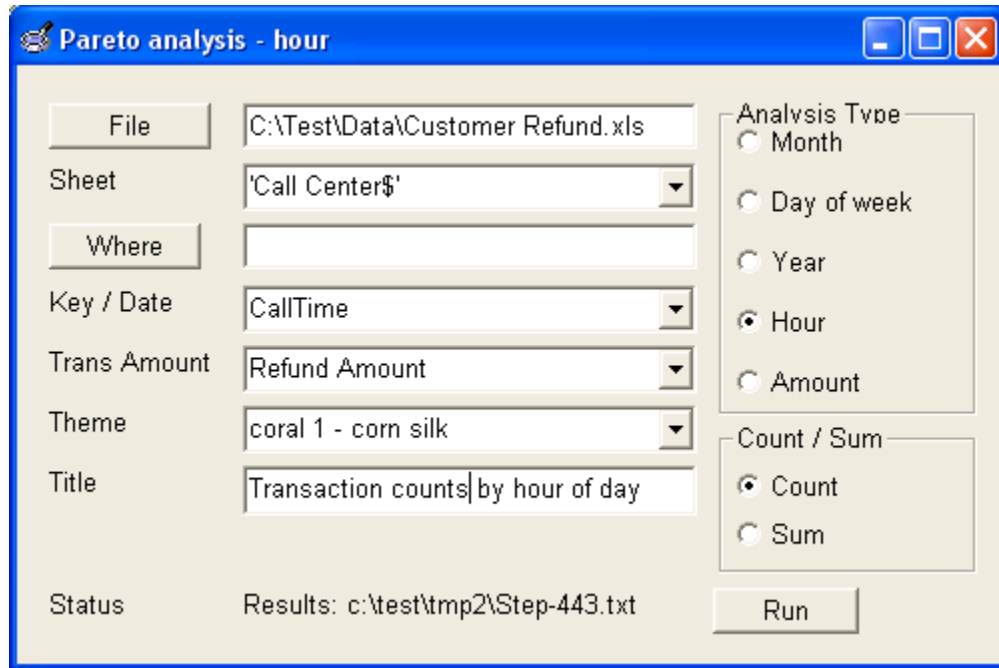
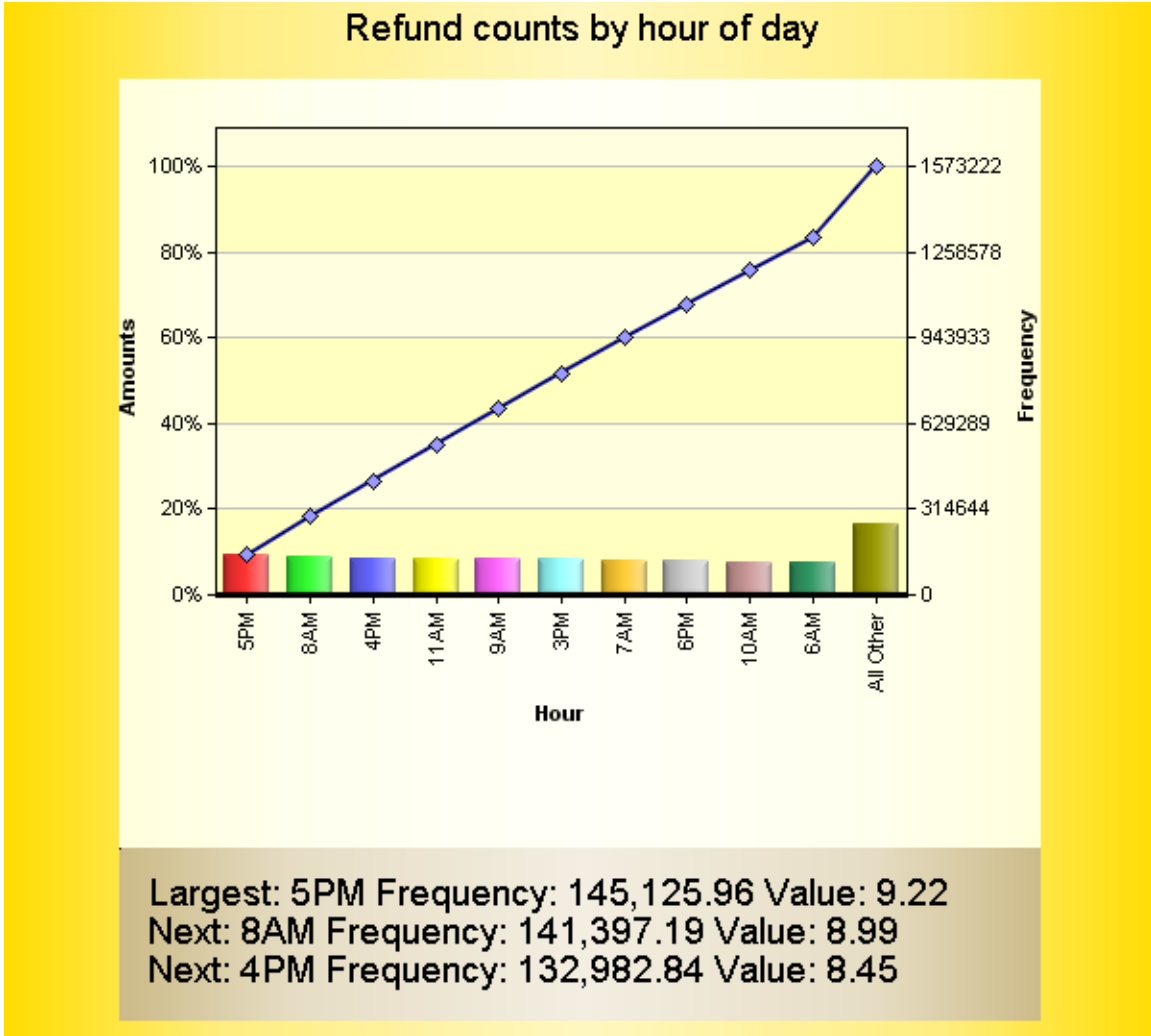
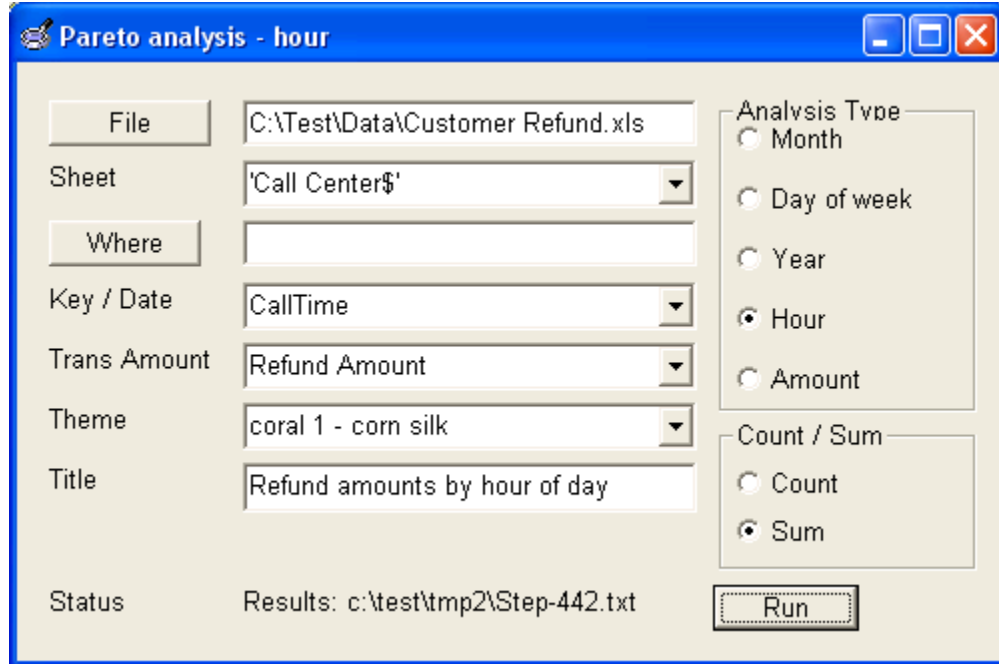


Chart Results – example 9



Refunds seem to be made fairly consistently during the day. However, note that there are refunds being made outside normal business hours, e.g. 7:00 a.m., 6:00 a.m., etc. Oddly, most refunds are being given between 5:00 and 5:59, which is after business hours...

Example 10 – Refund Amounts by Hour of Day



Use of Pareto Charts in Forensic Investigations

Chart results – example 10 – transaction totals by hour of day

