CHAPTER 3

FILTERING, SORTING, AND SUMMARIZING DATA

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INTRODUCTION

In the first two chapters, you created reports that simply project the rows of data in your database onto the report surface with minimal manipulation of that data. The value of Crystal Reports is its inherent capacity to convert those rows of raw data into valuable information. Information will reveal something about the data that cannot be found by simply poring over pages and pages of records. In the last chapter, you began to take advantage of the power of Crystal Reports by applying grouping to a report to organize the data into categorical groups. In this chapter, you build on that by learning how to create reports that perform the following actions:

- Filter data based on a given criteria
- Sort data based on field values
- Summarize and subtotal data

For more detailed information on grouping data, see “Working with Groups,” p. 64

FILTERING THE DATA IN YOUR REPORT

So far, the reports you have created have returned all the records from your database. Sometimes this is appropriate, but often reports need to filter the data based on specified criteria. This is most relevant when you're working with large databases in which there can easily be hundreds of thousands of records returned from a query, especially when joins are applied.

As with many features in Crystal Reports, there are multiple ways to filter data:

- Using the Select Expert—This simple method provides a visual way to specify filtering.
- Using the Record Selection Formula—This more granular, yet powerful, method involves creating a custom formula language expression to determine the filter criteria.

Regardless of the method used to filter your report, you should always make best efforts to filter on indexed database fields. By filtering on indexed fields, you realize the greatest performance on the database server. You can determine the indexed fields in a table by using the Crystal Reports Links tab on the Database Expert accessible from the Database menu. Use the Index Legend button and dialog provided to understand the different index markers in your database tables.

WORKING WITH THE SELECT EXPERT

The Select Expert is a design tool that enables you, the report designer, to specify basic yet powerful filters for the current report using a graphical design dialog. Figure 3.1 shows the Select Expert dialog. Let’s work through an illustrative example of filtering using the Select
Filtering the Data in Your Report

Expert. Taking what you have learned so far about creating simple columnar reports, create a new report from the Xtreme Sample Database 10, adding the Customer Name and Last Year's Sales fields from the Customer table to the details section of the report. Follow these steps to add a filter to this report:

1. To invoke the Select Expert, click its button found on the Experts toolbar or, alternatively, select the Select Expert option from the Report menu.

2. The first step in creating a filter is to choose which field the filter should be created on. Accordingly, the Choose Field dialog is displayed. Both fields that are present in the report and fields from the database are listed. A field does not need to be on the report to create a filter using it. At this point, if you forget which values are stored in any of the fields listed, click the Browse button to see a sample list of values. For this example, choose Last Year's Sales field and click OK. The Select Expert dialog appears, as shown in Figure 3.1.

   ![Figure 3.1](image)

   The Select Expert provides access to easy-to-use filtering functionality.

   The Select Expert dialog is shown with the last year's sales field selected.

   TIP

   Another quick and directed method of accessing the Select Expert is through the right-click menu available on any data field. This method opens the Select Expert directly with the specified field already selected as the filtered field and bypassing the Choose Field dialog.

3. The Select Expert has a group of tabs—one for each filter defined inside that report. In the case of your sample report, there is only one tab for the Last Year’s Sales field and another called <New>, which is used to define additional filters. By default, the filter setting on the Last Year’s Sales tab is set to Is Any Value. This means that regardless of the value of the Last Year’s Sales field, all records are included in the report. To change the filter in a report, change the value of the drop-down list. For this example, change it to Is Greater Than.

4. When this option is selected, another drop-down list appears. If the exact value to filter the field on is known, it can be typed into this list box. However, in this case, you might not know exactly what the values of the field are, so you are provided with the capability to browse that field’s values by simply pulling down the drop-down list. Choose $300.00 and click OK.
5. When returning to the report, you should notice that the report now only displays a single record: the Has Been Bikes company that had sales of $300. A more useful filter would be to show all records that were above or below a threshold. To accomplish this, re-open the Select Expert. This time, change the Is Equal To criteria to Is Greater Than and type 100,000 into the list box. When closing the Select Expert and returning to the report, a small collection of records should be returned. In just a few seconds, you’ve created a report showing your top customers.

Let’s look at a few more types of filters that can be applied to a report. The following steps walk you through applying these various types of filters:

1. Open the Select Expert again and change the criteria from Is Greater Than to Is Between.
2. This time, two list boxes are presented, each corresponding to an upper and lower bound. Type in the values 2,000 and 3,000, respectively (as shown in Figure 3.2), and click OK. The report displays all customers with sales between $2,000 and $3,000.

3. So far, only the Last Year’s Sales field has been used as a filter. However, any field can be used as a filter, although there are slightly different options for various field types. Go back into the Select Expert and, while on the Last Year’s Sales tab, click the Delete button to remove that filter.
4. Add a new filter on the Customer Name field by clicking the New button and selecting the Customer Name field from the subsequent dialog.
5. To have the report only show a single customer’s record, leave the criteria as Is Equal To and choose Alley Cat Cycles from the drop-down list. Applying this filter results in the report only showing a single record.
6. Return to the Select Expert and change the criteria to Is One Of. This option enables you to choose multiple values. Each time a value is selected from the drop-down list, it is added to the bottom of the list box. Select Alley Cat Cycles, Bikes R Us, and Hikers and Bikers and notice how the report now reflects those three records.

7. Next, remove the three values previously selected by highlighting them and clicking the Remove button. Now change the criteria to Is Like and type Wheel* into the drop-down list. Click Add or press Enter to add this item to the list. Applying this filter results in the report showing all customers whose names begin with the word Wheel.

**NOTE**

When using the Is Like option, an * acts as a wildcard for any number of characters, whereas a ? acts as a wildcard for only a single character. This can be quite useful when you're searching through textual fields for a specific text pattern.

The last thing this chapter covers with respect to the Select Expert is applying multiple filters. To do so, perform the following steps:

1. Start from scratch and delete any filters you have applied by clicking the Delete button on each tab.
2. Click the New button and add a new filter using the Last Year's Sales field.
3. Change the criteria to Is Less Than and the value to 5,000. This filter would result in showing all customers with sales of less than $5,000, but let's apply another condition.
4. Click the New button and add a new filter based on the Country field. Note that this is slightly different from the previous filters that have been created—not only because more than one filter is being applied at the same time, but also because the filter being created is based on a field that is not present on the report.
5. Change the criteria for the Country filter to Is Equal To and choose Canada from the drop-down list. Clicking OK applies this filter, resulting in a report with multiple conditions: customers from Canada with sales below $5,000. See Figure 3.3 for the output of this report.

**Figure 3.3**

A filter is applied to show all Canadian customers with sales less than $5,000.

**NOTE**

The two filters that were just added to the report are concatenated together by default with a logical AND statement, that is, All Customers with Last Year's Sales of less than $5,000 AND from Canada. This can be edited in the Formula Editor accessible from the Show Formula button on the Select Expert. This is discussed in the next section.
THE RECORD SELECTION FORMULA

Although the Select Expert is quite powerful, there are certain situations where you need to define a filter that is more complex than the Select Expert allows. Fortunately, Crystal Reports has a built-in formula language that enables custom expressions to be defined as a filter. In fact, this is one of the strengths of the Crystal Reports product: being able to use the formula language to attain a high level of control in various aspects of report creation.

Although you might not have realized it, even when you were using the Select Expert, a formula was being generated in the background that defined the filter. To see this in action, open the Select Expert and click the Show Formula button. This expands the Select Expert dialog to reveal the formula being generated. This formula is called the record selection formula. Notice that the formula’s value is as follows:

\{Customer.Last Year's Sales\} < $5000.00 and
\{Customer.Country\} = 'Canada'

The formula language is covered in more detail in Chapter 11, “Using Record Selections and Alerts for Interactive Reporting,” but the following are the key points to learn right now. In formulas, braces denote a field. For database fields, the table and field name are included and are separated by a period. The rest of the formula is a statement that tests whether the sales value is more than $5,000.

Think of a record selection formula as an expression that evaluates to a true or false result. For each record in the database, Crystal Reports applies the record selection formula, plugging in the current field values in place of the fields in braces. If the result of the statement is True, the record is included in the report. If the result of the statement is False, the record is excluded from the report. Let’s look at an example. The first record in the Customer’s table is that of City Cyclists who had sales of $20,045.27.

For this record, Crystal Reports evaluates the preceding formula, substituting $20,045.27 in place of \{Customer.Last Year's Sales\}. Because this value is larger than $5,000, this statement is False and the record is not included in the report. To see what other formulas look like, change the filter using the Select Expert to a few different settings and observe how the formula changes.

WORKING WITH THE FORMULA EDITOR

The formula shown at the bottom of the Select Expert is not just for informational purposes: It can be edited in-place. However, a much better editor exists for formulas. It’s called the Formula Editor (shown in Figure 3.4), and it can be invoked by clicking the Formula Editor button in the Select Expert or by selecting the Report menu and choosing Selection Formulas, Record. Although the formula language doesn’t change, the process of creating formulas becomes much simpler because of a focused user interface.

Let’s work through creating a simple record selection formula. This formula attempts to filter out any customers who owe more than $5,000 in tax. Tax owing will be defined as 2% of their sales figure. To implement this, work through the following steps:
1. To begin, launch the Formula Editor as described previously and delete the existing selection formula.

2. Next, create an expression that calculates the tax owing. To do this, enter the following expression:
   \( \{ \text{Customer.Last Year's Sales} \} \times 0.02 \)

3. The previous expression now represents the tax owing. To complete the expression to filter out all customers who owe less than $5,000 in tax, modify the formula to look like this:
   \( \{ \text{Customer.Last Year's Sales} \} \times 0.02 \) > 5000

4. To complete the formula and apply the filter, click the Close button at the top-left corner of the Formula Editor window, and then click OK to close the Select Expert. Focus returns to the report, and when data is refreshed, only a handful of customers should be listed on the report.

Both the formula language and the Formula Editor are topics unto themselves and will be discussed in more detail in Chapter 4, “Understanding and Implementing Formulas,” and Chapter 11, “Using Record Selections and Alerts for Interactive Reporting.”

**Learning to Sort Records**

Although filtering is one of the key components of an effective report, it alone is not enough. Often, to properly see the key pieces of data, a report needs to be sorted. Crystal Reports is quite flexible when it comes to sorting, allowing any field type to be sorted, as well as multiple ascending or descending sorts. Sorting is applied using the Sort Expert.
WORKING WITH THE SORT EXPERT

The Sort Expert is launched from a button on the Experts toolbar, and also via the Record Sort Expert item on the Report menu. Figure 3.5 shows the Sort Expert.

To apply sorting to the report, select a field from the list of available fields on the left side of the dialog area, and click the arrow (>) button to add that field to the Sort Fields list. Note that like filters, sorts can use fields both on the report and fields not otherwise used in the report.

TIP

In addition to sorting on report and database fields, you can sort on formula fields. Creating a formula field enables you to sort a report based on a custom expression.

To see this in action, follow these steps:

1. Create a new report using the Employee table of the Xtreme Sample Database and add the First Name, Last Name, and Salary fields to the report.
2. Initially, this report doesn’t tell you a lot because the data is in seemingly random order. However, if the report were sorted by last name, it would be more useful. To accomplish this, first launch the Sort Expert.
3. Select the Last Name field from the available fields list and click the arrow (>) button to apply a sort on it. Click OK to return to the report. Notice how the report’s records are now sorted in alphabetical order by last name.

The Sort Expert enables you to sort on both alphabetic and numeric fields. To modify this report to sort on salary instead of last name, follow these steps:

1. Return to the Sort Expert and remove the current sort by selecting the Last Name field from the sort fields list and clicking the < button.
2. Now select the Salary field and add it to the sort fields list.
3. Alphabetic fields are usually sorted in ascending order (from A to Z), but numeric fields are often sorted both ways. In this case, select the Salary field in the Sort Fields list and
click Descending for the sort direction. This lists the employees with the top salary first. Click OK to apply the sort and return to the report.

Notice that some employees have the same salary level. If you wanted to perform a secondary sort within duplicates of the primary sort field, you can simply add another sort field. These sort fields can be arranged up and down using the buttons near the top-right corner of the Sort Expert.

**Creating Effective Summaries**

The third key aspect of a good report after filtering and sorting is summarizing. Summarizing creates totals and subtotals that help the viewer of the report understand the data better. The following sections discuss various types of summarizing.

**Creating Grand Totals**

The simplest kind of summary is a grand total. This takes a single field and creates a total at the end of the report. To try this out, create a new report from the Orders table and add both the Order ID and the Order Amount fields onto the report.

Initially, this report is more than 30 pages long. A report of this length would make it very difficult to estimate the total amount of all orders, but a summary does that quite easily. Right-click the Order Amount field and select Insert, Summary from the context menu. This opens the Insert Summary dialog shown in Figure 3.6. To insert a summary, the first thing you need to specify is the field to summarize. Because you right-clicked the Order Amount field, this is already filled in for you. The next piece of information to fill in is the summary operation. The default is Sum, which you'll leave as its default. Finally, Crystal Reports needs to know for which group the summary should be performed. Because there is no grouping in this report, the only option is Grand Total, which is already filled in for you. Click OK to close this dialog.

When looking at the end of the report, you see a grand total of the order amount is now visible in bold text. To edit the summary, right-click on it and select Edit Summary from the context menu. This opens the Edit Summary dialog. Try changing the calculation from Sum to Average. This now updates the summary to show the average order amount. There are various calculations to choose from including minimum, maximum, variance, count, deviation, and median.

Besides the order amount total, it might be helpful to know how many orders there are. To do this, right-click the Order ID field and select Insert, Summary. Change the calculation from Sum to Count and click OK. Now besides the order amount summary, there is a count of all orders.

**Creating Group Summaries**

Although grand totals are useful, summarizing starts to become really powerful when it is applied at the group level. This enables totaling for each level of a group and tells more about the data than a simple grand total does because it measures the relationships between the various groups. To apply a group summary, a group must first exist in the report.
Using the same report from the last example with the Order ID and Order Amount fields, insert a group on the Ship Via field. This produces a report showing all the orders grouped by the method they were shipped with, for example, FedEx, Loomis, and so on. To compare the different methods of shipment, right-click the Order Amount field and select Insert, Summary. Previously, when you created a grand total, you accepted all the defaults in this dialog. But this time, the summary location needs to be changed. Change Grand Total (Report Footer) to Group #1: Orders.Ship Via in the Summary Location drop-down box, and click OK.

Now a total field is inserted into the report, which acts much like the grand total except that the total is repeated for each group. By examining these summaries, you can determined that the largest order amount was shipped via UPS. You could also add a group-level summary to the Order ID field to determine the count of orders for each shipping method. Doing this reveals that the most orders were shipped via Loomis. These conclusions would have been difficult to reach without an effective summary.

**TIP**

When groups have many records inside of them, it sometimes becomes difficult to compare summaries because they aren’t all visible on the page at the same time. A good tip for comparing these values is to hide the details section, which contains all the records, and only display the group header and footer that normally contains the group name and its summary. To hide the details section, move to the Design tab, right-click the Details bar on the left side of the screen, and select Hide.

**USING GROUP SELECTION AND SORTING**

On the topic of group summaries comes group selection and sorting. This brings together both filtering and summarizing concepts. Group selection and sorting is to groups what
Creating Effective Summaries

Record selection is to records. In other words, defining a group selection or sorting defines which groups are included in the report and in which order, respectively. A key point to understand is that whereas record selection and sorting work from values of individual fields, group selection and sorting work from summary fields.

In the example from the previous “Creating Group Summaries” section, you created a report that displayed all orders grouped by the shipment method but to determine which shipment method shipped the highest dollar value of orders, you had to manually browse through the report comparing the numbers. Applying a group sort would provide an easy way to see the rankings. Also, what if you only wanted to show the top three shipment methods? Group selection provides a way to filter out groups in such a manner.

As you might expect, there is an expert for applying group selection and sorting. It’s called the Group Sort Expert, and it can be found on the Experts toolbar, as well as from the Group Sort Expert item on the Report menu. When the Group Sort Expert is launched, it displays one tab for each group in the report. In the previous example, there was only a single group on the Ship Via field so that’s what you should see. Inside that tab, there is initially only a single list box with a value of No Sort. Changing this list box to All displays a set of options very similar to that of the Record Sort Expert—except instead of having a list of all report fields to choose to sort on, only summaries are listed.

The Group Sort Expert should have initially selected the Sum of Orders.Order Amount summary field and selected Ascending order. In this case, because it’s more useful to see the highest dollar value first rather than last, change the sort order to Descending. Clicking OK closes the Group Sort Expert and returns focus to the report, which should have re-ordered the groups from largest to smallest. It’s easy to see now that UPS was the method that shipped the highest dollar amount because it is the first group to appear.

There are only six shipment methods, but you can imagine reports that contain many more groups than six. Even if the groups are sorted, sometimes it’s just too much data for the consumer of the report to absorb. To solve this problem, you can apply a group selection. To do this, launch the Group Sort Expert and change the All option on the left to Top N. Notice that the options are different from sorting. Applying a Top N selection implies that the groups will be sorted, but enables you to only display a specified number of the top groups in order. The default value is 5: Change this value to 3.

Another important option is relating to the set of groups that are excluded by the group selection. By default, these groups are all combined under a new group called Others. You might or might not want to include this Others group in your report. If you choose not to, uncheck the option labeled Include Others. Clicking OK returns focus to the report that now should only display the top three shipment methods based on the total order amount.

**Note**

Like the record selection, the group selection also has a formula that can be defined to use a custom expression to determine which groups to include in the report. The group selection formula can be found on the Report menu, under Selection Formulas, Group.
Some other options available in the group sort expert include Bottom N, which is the opposite of Top N, and Top and Bottom Percentage, which allow a filtering of the top \( x \) percent of groups.

**CAUTION**

It is instructive to note that group selection formulas are executed on the second pass of the Crystal Reports Engine. This second pass takes place after grand totals, group subtotals, and the group navigation tree have been created. To understand the nuances of multi-pass reporting, review the last topic in Chapter 4.

**CREATING RUNNING TOTALS**

The last kind of summary to be discussed in this chapter is a running total. In some older versions of Crystal Reports, to create a running total, you had to create a collection of formula fields, so a feature was added just to handle running totals. To illustrate this, follow these steps:

1. Create a new report using the Orders table. Add the Order ID, Order Date, and Order Amount fields to the details section of the report. You can reformat the order date to a more user-friendly format if you prefer by right-clicking the field and selecting Format.

2. Add a sort based on the Order Date field. This report now shows all orders in the order they were placed. This is a perfect scenario for a running total that would show a cumulative total of orders so that the viewer of the report could see what the current order amount was at any given time.

3. To add a running total, right-click the Order Amount field and select Insert, Running Total from the Context menu. The Create Running Total Field dialog is shown in Figure 3.7.

![Figure 3.7](image)
Four pieces of information need to be provided in this dialog, including

- **Name of the running total field.** The default is somewhat cryptic; it’s best to give this a more meaningful name.

- **The summary to perform.** The Field to Summarize should be prepopulated for you, but you can change the summary type from the default of sum to other standard summary types. Some of the more useful types for a running total are Count and Average.

- **When to evaluate the running total.** The default and most common setting here is For Each Record, but this can be modified to only be evaluated when the value of another field is changed or a group value is changed, or you can define a custom formula that defines the evaluation criteria.

- **When to reset the running total.** This setting determines whether the running total should reset itself. If no groups are present in the report, you’ll likely want to keep the default of Never. But if you have groups, you might want to reset the running total for each group or define more complex criteria with a formula.

4. For our example, give the running total a name of Cumulative Orders and leave all other settings at their defaults. Completing this running total adds this new field to the report next to the Order Amount field and provides a cumulative total of orders. The output of this report is shown in Figure 3.8.
Troubleshooting

Group Selection Formula

Where can I find the Group Selection formula?
The group selection formula can be found on the Report menu, under Selection Formulas, Group.

Crystal Reports in the Real World—Nesting Formulas

It’s common for some more complex formulas to be combined to provide specific insight into report data. For example, a user might need to have a report that lists all customers with their total sales, but also show the average value of sales over a given amount. As described previously, there are many ways that a report design expert can approach this; what follows is one method.

1. Open the report Chap3RunningTotal.rpt. Insert a group on Customer ID. Select the running total field, right-click it, and choose Edit Running Total. Under the Reset section, choose On Change Of Group. Now the report is ready for the new functionality and should look like Figure 3.9.

2. Create a new formula named Large Orders with the following code:

   ```vql
   WhileReadingRecords;
   If {Orders.Order Amount} > 3000 Then
   {Orders.Order Amount}
   Else
   0;
   ```

3. Add this formula to the report. Right-click on the new formula field and select Insert, Summary and for the section Summary Location change this value to your Group 1 field. This creates the numerator for your average.

4. Next, to determine the value for the denominator, right-click the Large Orders formula and choose Insert, Running Total. For Type Of Summary select Count; for Evaluate, select Formula and enter the following code:

   ```vql
   {@Large Orders}>0
   ```

   Under Reset select Group 1. Check your settings against Figure 3.10.

Note

Running totals can also be created from the Field Explorer by selecting the Running Total Field item and clicking the New button or right-clicking and selecting New from the context menu. Creating a field in this way does not automatically add it to the report; you need to place it on the report in a desired location yourself.
5. Now with the numerator and denominator values defined, simply create a new formula
with the following code:
   \[
   \text{Sum (@Large Orders)}/\#\text{Total0}
   \]
6. Insert this new formula onto the Group Footer and the report now has a summary
value showing the average of all orders greater than $3,000 (see Figure 3.11).
7. Save the report as Chap3AverageLargeOrder.rpt.
### Figure 3.11
A report complete with complex formulas.

<table>
<thead>
<tr>
<th>Order ID</th>
<th>Order Date</th>
<th>Order Amount</th>
<th>Cumulative Orders</th>
<th>Large Orders</th>
<th>BTot</th>
<th></th>
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CHAPTER 4

UNDERSTANDING AND IMPLEMENTING FORMULAS

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