MIS 5208 – L5 ACL: Working with Expressions

Audit Command Language Fundamentals

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Working with Expressions

- Expressions are statements used primarily to create filters and computed fields.
- They perform:
  - Calculations,
  - Specify logical conditions,
  - Create values that do not exist in the data file.
- Expressions can be:
  - Named and saved as part of a project
  - Created just for immediate use (temporary)
- The output of an expression can be returned in any of the four data types:
  - logical
  - character
  - numeric
  - datetime

- Filters (Logical expressions)
  - Filters are logical expressions, that select records in your analysis file based on a particular - evaluating each record as being:
    - True
    - False
  - Logical expressions restrict the viewed records based on the expression criteria
  - For example, you can create a filter that selects only records that fall within a specified range of dates.

Expression	Output Data Type	Detail
InvoiceAmt > 10000	Logical (True/ False)	Filters records and only includes records with invoice amounts over 10,000
UPPER(LastName)	Character	Converts all alpha characters in the last name to upper case
InvoiceAmt * .06	Numeric	Calculates 6% of the invoice amount
InvoiceDate + 30	Datetime	Adds 30 days to the invoice date to calculate the due date

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Computed Fields

- A computed field is:
  - Virtual
  - Derived from a calculation that references either physical field(s) and/or previously created computed field(s).
  - Return:
    - Character (character)
    - Numeric (numeric)
    - Date (datetime)
    - Logical values
    - Conditional or unconditional.
  - Once created, they can be treated as physical fields.
- ACL Analytics evaluates expressions from left to right, according to the following rules:
  - Operators are evaluated in order of arithmetic precedence.
  - Use parentheses ( ) to modify the order in which the expression is evaluated.
  - Each operator works only if its operands are of an acceptable type.

Operator	Description
( )	Parentheses – specify operator precedence.
NOT	Logical NOT
* / (these operators have equal precedence)	Multiply Divide
+ - (these operators have equal precedence)	Add Subtract
> < = >= <= <> (these operators have equal precedence)	Greater than Less than Equal to Greater than or equal to Less than or equal to Not equal to
AND (or &)	Logical AND
OR (or |)	Logical OR

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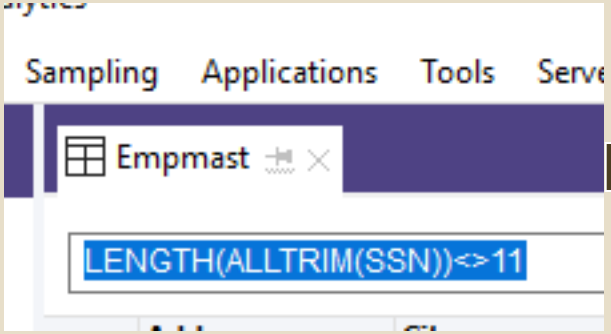
Using Expressions

- Valuable and flexible tool - use them to:
  - Perform a wide range of calculations
  - Create filters
  - Prepare data for analysis
  - Create computed fields
- Expression Content
  - Data fields
  - Functions
  - Literals
  - Constants
  - Variables
  - Arithmetic or logical operators



SSN LENGTH	SSN Length Validation	Social Security Number
10	F	285-5-1960
10	F	490-0-4891
10	F	732-24-682
10	F	149-7-5423
10	F	922-60-581
10	F	896-6-5346
10	F	671-75-996
10	F	536-0-8405
9	F	214-1-695
10	F	47-99-8438

Source: ACL Analytics On Line User Guide (https://enablement.acl.com/helpdocs/analytics/12/user-guide/en-us/Default.htm#cshid=using-expressions)

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Using Expressions

Expression type	Required content	Example
Character	Contains any of the following: ○ character fields ○ variables that contain character data ○ functions that return character values ○ quoted character strings (character literals)	Extract the digits from a product code and discard the three-character prefix: ○ `SUBSTR(Product_code, 4, 10)`
Numeric	Contains any of the following: ○ numeric fields ○ variables that contain numeric data ○ functions that return numeric values ○ literal numeric values, without quotation marks – limited to digits, a minus sign if needed, and a decimal point if needed	Calculate sale price plus tax: ○ `Sale_price * 1.07` Find the maximum value across three fields: ○ `MAXIMUM(Min_Qty, Qty_on_hand, Qty_on_order)`
Datetime	Contains any of the following: ○ datetime fields ○ variables that contain datetime data ○ functions that return datetime values ○ quoted datetime values (datetime literals) The Datetime data type encompasses three subtypes: date, datetime, and time. Quoted datetime values require backquotes – for example, `` `20141231` `` or `` `20141231.235959` ``. The backquote (`) is the lowercase key at the upper left corner of the keyboard.	Calculate the elapsed days between the two dates: ○ `` `20141231` - `20141130` `` Calculate the elapsed time between values in two time fields: ○ `Finish_Time - Start_Time`
Logical	Contains any of the following: ○ an operation that produces a logical result of True or False (`T` or `F`) ○ functions that return logical values If `T` or `F` are part of the expression, they must be entered without quotation marks. **Note** A logical expression can reference fields, variables, or literals of any data type.	Find all records with a payment date past the due date: ○ `Payment_date > Due_date` Filter records in a table on three cities: ○ `MATCH(Vendor_City, "Phoenix", "Austin", "Los Angeles")`

Source: ACL Analytics On Line User Guide (https://enablement.acl.com/helpdocs/analytics/12/user-guide/en-us/Default.htm#cshid=using-expressions)

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Using Expressions

Operator precedence	Arithmetic and logical precedence dictates the order in which operators are evaluated. See Operators in ACL expressions. Use parentheses **( )** to modify the order in which the operators are evaluated.
Operand data type	Each operator works only if its operands are of a compatible data type.
Function parentheses	All *ACL* functions require parentheses. Everything inside a function's parentheses is evaluated first, before any other parts of an expression outside the function's parentheses.
Comparing character strings	By default, when character strings of different lengths are compared, the shorter of the two lengths is used. If the **Exact Character Comparisons** option is selected in the **Tables** tab in the **Options** dialog box, the longer of the two lengths is used. For more information, see Table tab (Options dialog box).
Decimal precision	If numbers with different precision are mixed in numerical operations, the result retains the decimal places of the operand with the largest number of decimal places in the expression. For example: ○ 4 + 5.0 = 9.0 ○ 1.1 * 1.1 = 1.2 ○ 6 * 2.000000 = 12.000000 **Note** You can use the SET MATH command to change the number of decimal places that result from a mathematical operation.

Source: ACL Analytics On Line User Guide (https://enablement.acl.com/helpdocs/analytics/12/user-guide/en-us/Default.htm#cshid=using-expressions)

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Expression Operators

Operators in order of precedence	Description
( )	Parentheses – modify operator precedence, or enclose function parameters
NOT -	Logical NOT Unary minus – minus sign, indicates a negative number
^	Exponentiation – raises a number to a power
* / (operators have equal precedence and are evaluated from left to right)	Multiply Divide
+ - (operators have equal precedence and are evaluated from left to right)	Add Subtract
+	Concatenate character strings
>= <= <> (operators have equal precedence and are evaluated from left to right)	Greater than Less than Equal to Greater than or equal to Less than or equal to Not equal to
AND (or **&**)	Logical AND
OR (or |)	Logical OR

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Filtering

- A filter sifts records, only returning those that meet specified conditions; filters evaluate as true or false and
-
-
- strings, dates, or values.

Field Type	Field	Operator	String/ Value/ Date	Filter	Explanation
Character	LastName	=	"SMITH"	LastName ="SMITH"	Character strings must be enclosed in double quotation marks
Character	Location	=	"04"	Location = "04"	Numeric digits in a character field are treated as character strings
Numeric	InvoiceAmt	>	10000	InvoiceAmt > 10000	Numeric values don't need formatting. Commas as separators are not allowed
Numeric	InvoiceAmt	<>	-10000	InvoiceAmt <> -10000	Use a leading minus sign for negative amounts
Datetime	InvoiceDate	>=	`20161001`	InvoiceDate >= `20161001`	Datetime values must be entered in the format `YYYYMMDD` or `YYYYMMDD hhmmss` surrounded in grave accents (AKA backticks).

Source: ACL Analytics Foundations (https://academy.acl.com/unit/view/id:7465)

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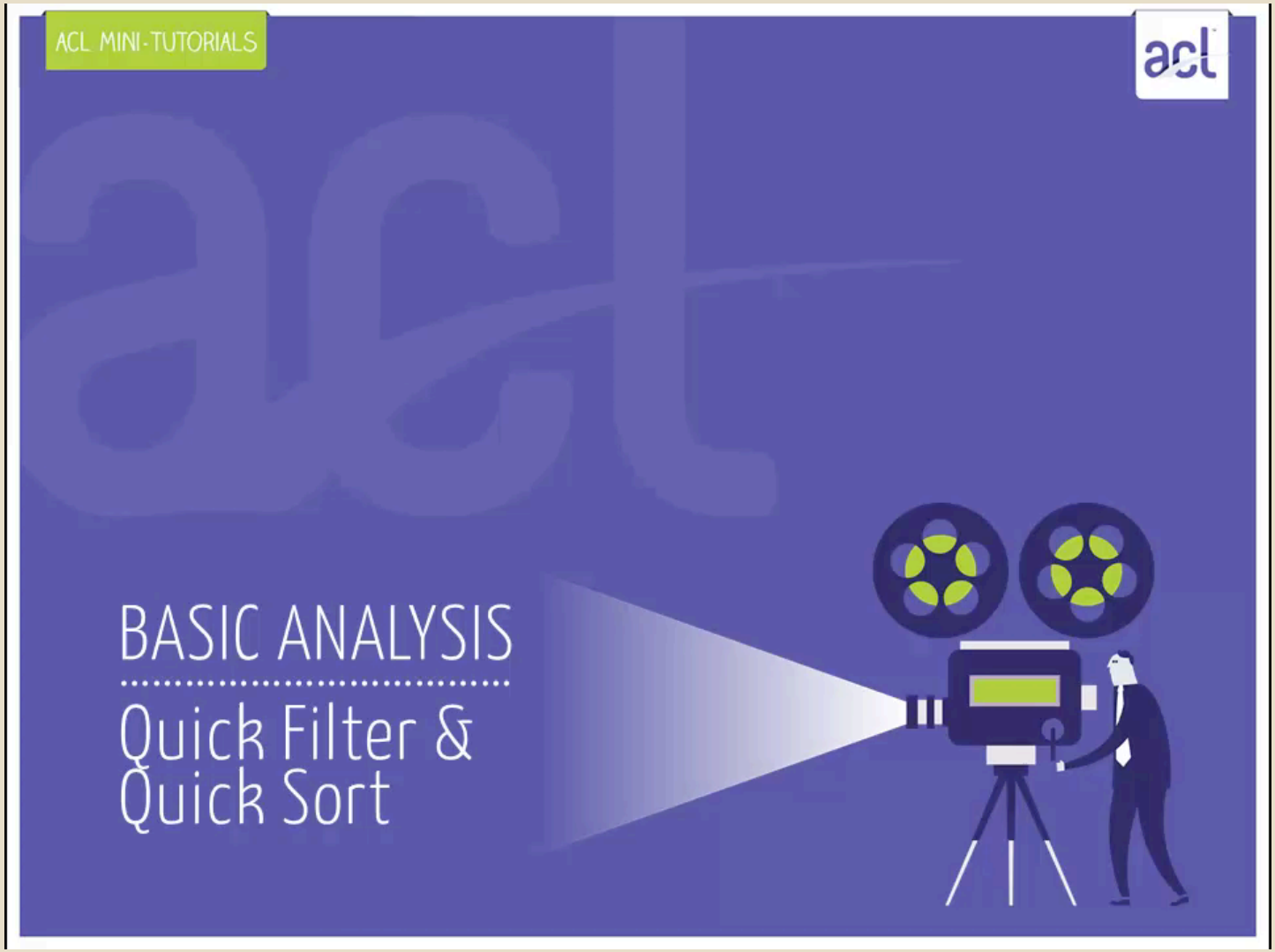
Create Filters and Quick Filters



Source: ACL Analytics Foundations (https://academy.acl.com/unit/view/id:7466)

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Searching Using Filters

- Search for a Starting String
  - Filters can be used to find specific words. By default, **search behaves like a wildcard** (looks for every occurrence where the value begins with the filter string; it doesn't matter what is after the string).
  - When the filter, fieldname = "string" is constructed:
  - The string being searched for must be at the start of the field.
  - Alpha characters (A-Z) are case sensitive
- Only character fields can be used for word searches.
- The search can be performed on any characters within the field (A-Z, 0-9, or symbols).

- The wildcard behavior is controlled by Exact Character Comparisons (ECC).
- If ECC is on, the remainder of the field value after the search for string must be blank in order for it to be picked up.
- The table shows how values will evaluate if ECC is turned on or off.

LastName	Result		
	ECC Off	ECC On	FIND( )
SMITH	✓	✓	✓
Smith	✘	✘	✓
SMITHSON	✓	✘	✓
SMItHSON	✘	✘	✓
SMITHSOnian	✓	✘	✓
BLACKSMITH	✘	✘	✓
BlackSMITH	✘	✘	✓

Consider the filter LastName = "SMITH"

Source: ACL Analytics Foundations (https://academy.acl.com/unit/view/id:7467)

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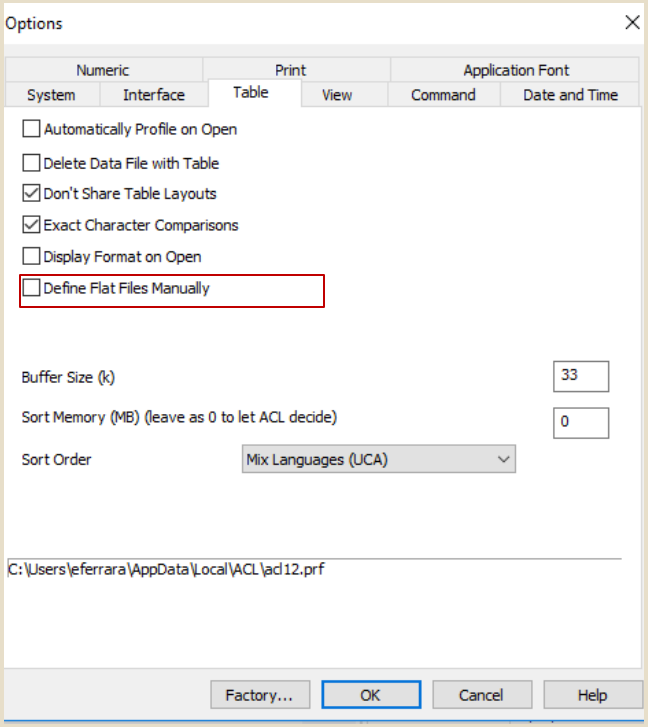
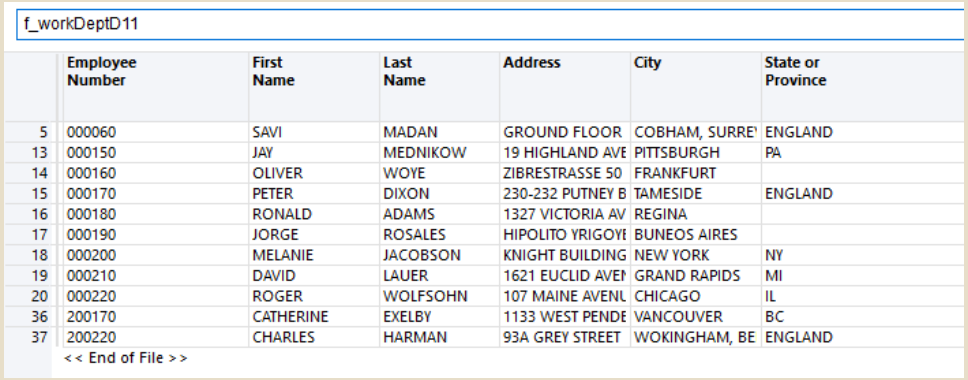
Turning ECC On / Off

ECC can be found under **Tools** > **Options >Table**.





f_workDeptD11

	Employee Number	First Name	Last Name	Address	City	State or Province
5	000060	SAVI	MADAN	GROUND FLOOR	COBHAM, SURRE	ENGLAND
13	000150	JAY	MEDNIKOW	19 HIGHLAND AVE	PITTSBURGH	PA
14	000160	OLIVER	WOYE	ZIBRESTRASSE 50	FRANKFURT	
15	000170	PETER	DIXON	230-232 PUTNEY B	TAMESIDE	ENGLAND
16	000180	RONALD	ADAMS	1327 VICTORIA AV	REGINA	
17	000190	JORGE	ROSALES	HIPOLITO YRIGOYE	BUNEOS AIRES	
18	000200	MELANIE	JACOBSON	KNIGHT BUILDING	NEW YORK	NY
19	000210	DAVID	LAUER	1621 EUCLID AVEI	GRAND RAPIDS	MI
20	000220	ROGER	WOLFSOHN	107 MAINE AVENU	CHICAGO	IL
36	200170	CATHERINE	EXELBY	1133 WEST PENDE	VANCOUVER	BC
37	200220	CHARLES	HARMAN	93A GREY STREET	WOKINGHAM, BE	ENGLAND

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Source: ACL Analytics Foundations (https://academy.acl.com/unit/view/id:7467)

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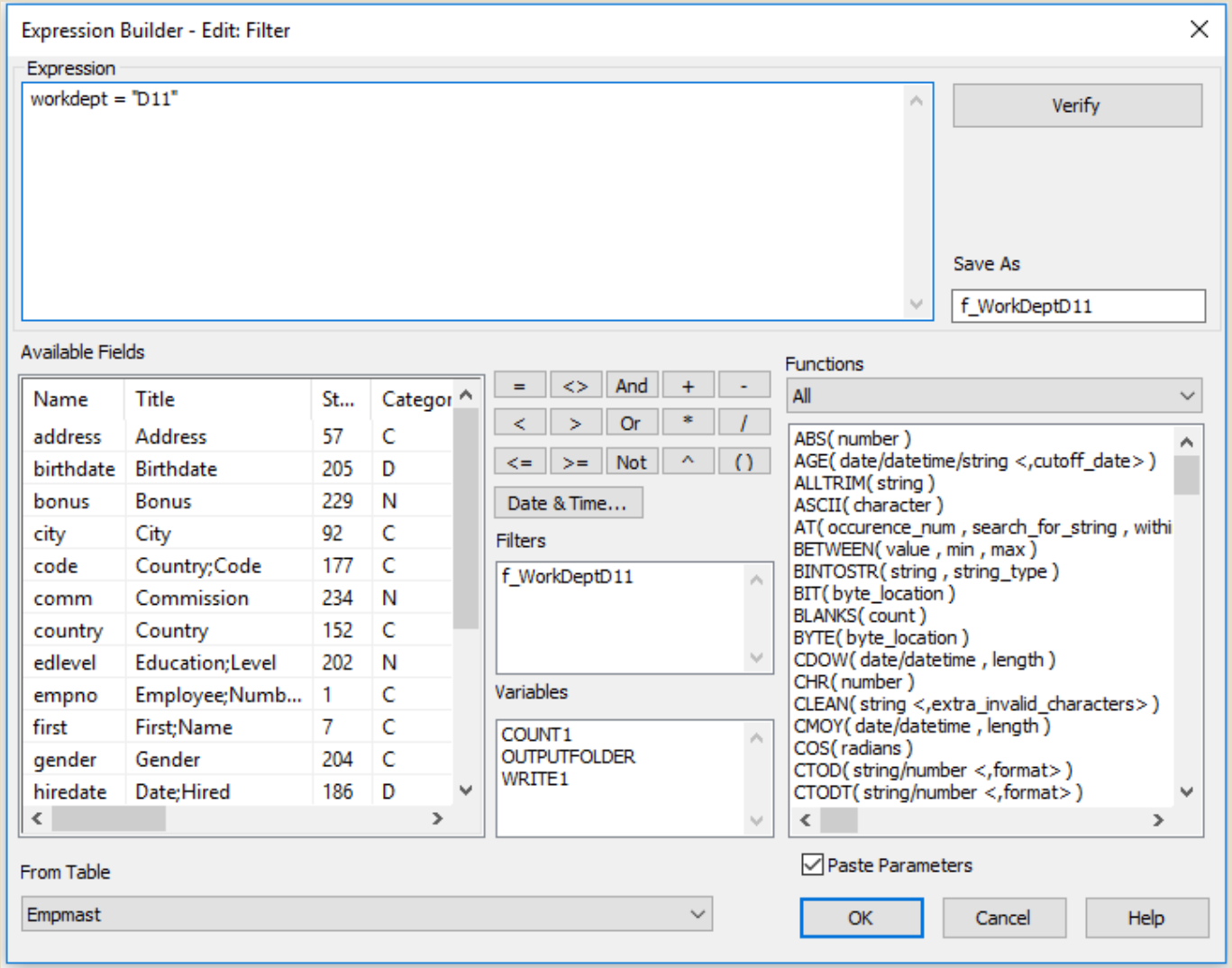
Expression Builder



Source: ACL Analytics Software v12

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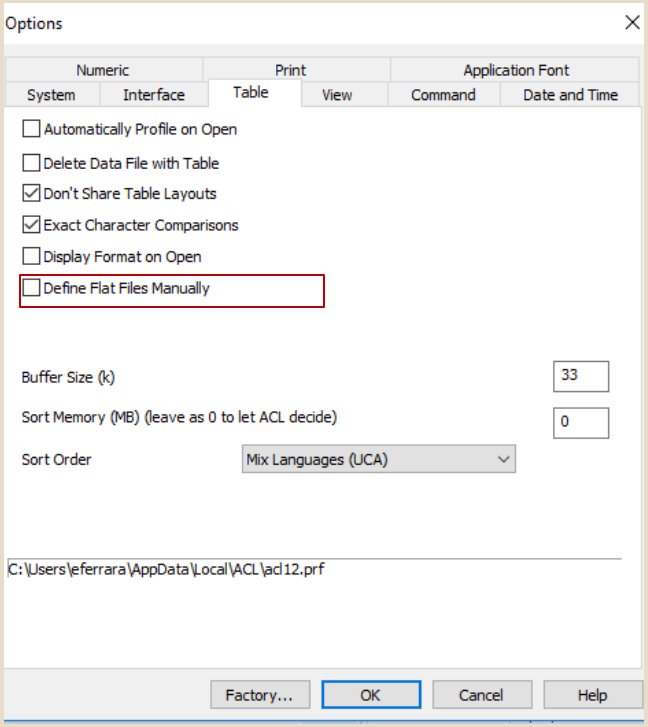
Applying Filters – Dynamic & Programmatic

ECC can be found under **Tools** > **Options >Table**.



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14	000160	OLIVER	WOYE	ZIBRESTRASSE 50	FRANKFURT	
15	000170	PETER	DIXON	230-232 PUTNEY B	TAMESIDE	ENGLAND
16	000180	RONALD	ADAMS	1327 VICTORIA AV	REGINA	
17	000190	JORGE	ROSALES	HIPOLITO YRIGOYE	BUNEOS AIRES	
18	000200	MELANIE	JACOBSON	KNIGHT BUILDING	NEW YORK	NY
19	000210	DAVID	LAUER	1621 EUCLID AVEN	GRAND RAPIDS	MI
20	000220	ROGER	WOLFSOHN	107 MAINE AVENU	CHICAGO	IL
36	200170	CATHERINE	EXELBY	1133 WEST PENDE	VANCOUVER	BC
37	200220	CHARLES	HARMAN	93A GREY STREET	WOKINGHAM, BE	ENGLAND

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workDept="D11"

	Employee Number	First Name	Last Name	Address	City	State or Province
5	000060	SAVI	MADAN	GROUND FLOOR	COBHAM, SURRE	ENGLAND
13	000150	JAY	MEDNIKOW	19 HIGHLAND AVE	PITTSBURGH	PA
14	000160	OLIVER	WOYE	ZIBRESTRASSE 50	FRANKFURT	
15	000170	PETER	DIXON	230-232 PUTNEY B	TAMESIDE	ENGLAND
16	000180	RONALD	ADAMS	1327 VICTORIA AV	REGINA	
17	000190	JORGE	ROSALES	HIPOLITO YRIGOYE	BUNEOS AIRES	
18	000200	MELANIE	JACOBSON	KNIGHT BUILDING	NEW YORK	NY
19	000210	DAVID	LAUER	1621 EUCLID AVE	GRAND RAPIDS	MI
20	000220	ROGER	WOLFSOHN	107 MAINE AVENU	CHICAGO	IL
36	200170	CATHERINE	EXELBY	1133 WEST PENDE	VANCOUVER	BC
37	200220	CHARLES	HARMAN	93A GREY STREET	WOKINGHAM, BE	ENGLAND

<< End of File >>

Source: ACL Analytics Software v12

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  - Only character fields can be used for word searches.
  - The search can be performed on any characters within the field (A-Z, 0-9, or symbols)

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Filter & Searching Class Activity

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Filter with Conditionals

How many customers have a credit limit of at least $10,000 AND belong to Sales Rep 00210, 00140, or 00190?

```
limit>=10000 and (sales_rep_no = "00210" or sales_rep_no = "00140" or sales_rep_no = "00190")
```

	Cust No	Cust Name	Street Address	City	State	Zip Code	Credit Limit	Sales Rep Number
1	35189	VERSA TIRES	51001 BORNEO RD	PITTSBURGH	TX	75686	32000	00210
10	820025	UNITED CITY	920 4TH STREET	BRIDGEWAT	NJ	08807	46000	00140
14	878035	BLUE SERVICES GROUP	7600 WAKE FOREST F	MALVERN	PA	19355	79000	00190
23	797352	FIRST HEALTHCARE	88 STATE ST	AUSTIN	TX	78752	28000	00210
30	329169	1ST TECHNOLOGY GROUP	7837 WALMSLEY AVE	SECAUCUS	NJ	07094	25000	00140
33	478604	NATURAL INTERNATIONAL	39 NORTH RD	FORT WASH	PA	19034	31000	00190
36	512328	LIFEGUARD SOFTWARE	1847 SANTA FELIPA ST	BASKING RI	NJ	07920	99000	00140
37	264629	BLACK INTERNATIONAL	830 CENTRAL AVE	NEWARK	NJ	07102	11000	00140
49	250402	LOOP INDUSTRY	2900 RIVERGRADE RI	WILLOW GR	PA	19090	14000	00190
53	925007	GALAXY COMPANY	744 W 20TH ST	HARRISBUR	PA	17111	18000	00190
54	562270	ALPHA SERVICE	1 HUGHESTON TOWE	RED BANK	NJ	07701	64000	00140
60	241370	BALSAM INDUSTRIES	345 SUMMER ST	PHILADELPH	PA	19107	22000	00190
64	301037	JOINT NATIONAL INC.	800 PARK ST	WAYNE	NJ	07470	63000	00140

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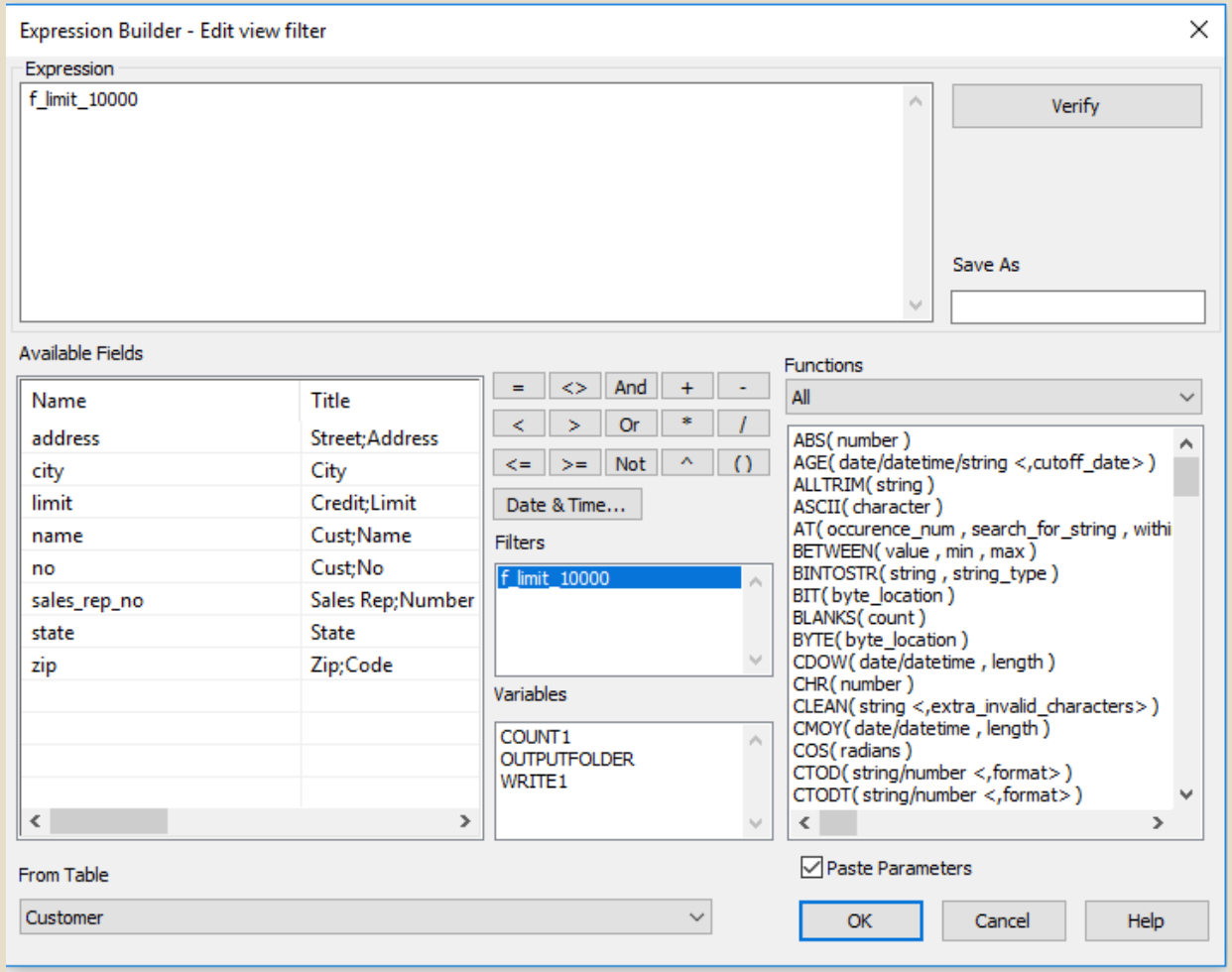
Filters with Expression Builder



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Class Activity

- How many customers have a credit limit of at least $10000 AND belong to Sales Rep 00210, 00140, or 00190?
- Create a filter named limit_less_10000.
- Using your saved filter, limit_less_10000, build a filter that will display customers who do not have a limit of at least $10000. Which operator will accomplish this?
- Create a filter names f_limit_less_10000. Using your saved filter, build a filter that will display customers who do not have a limit of at least $10000. Which operator will accomplish this?
- How many customers have a credit limit less than $10000?
- How many customers belong to Sales Rep 00210?
- In total, how many customers belong to Sales Rep 00210, 00140, or 00190?

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Unconditional Computed Fields

- An unconditional computed field applies the same expression to every record in the file.
- Note:
  - A computed field must be named and always saved to your work file.
- Example:
  - In a sales transaction file, every transaction requires a discount to be calculated on the final amount at 10%.
  - The expression needs to be applied unilaterally (unconditionally) to every record.

Source: ACL Analytics Foundations (https://academy.acl.com/unit/view/id:7470)

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Unconditional Computed Fields

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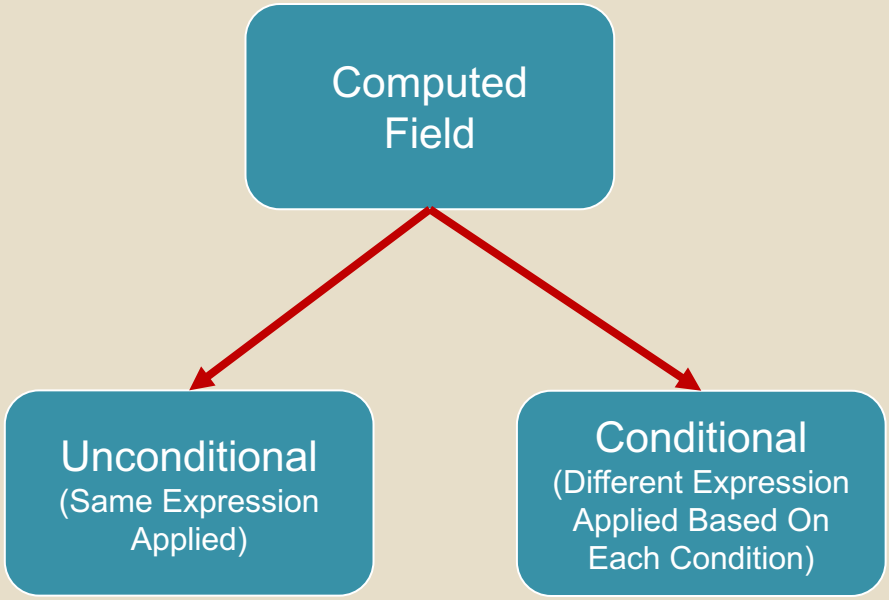
Computed Fields

- Only exist in the table and are not a part of the data source.
- Must be named.
- Can return a character, numeric or date output.
- The rules for using the Expression Builder to create a computed field are similar to those for creating a filter as detailed in the Expression Builder page.



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Thank you.

Computed Field Class Activity

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Class Activity

- Background: Since pay checks are issued monthly, the pay_per_period for each employee should equal 1/12th of their salary:
  - Calculate the variance (difference) between the original salary field and the computed field, c_SalaryRecalc, create another field called c_SalaryVariance.
  - Positive values in the c_SalaryRecalc field should reflect pay period overpayments.
  - Select Edit > Table Layout.
  - Click the Add a New Expression button.Under name enter c_SalaryRecalc.Click on the f(x) button and enter the syntax pay_per_period * 12 .
  - Click OK.
  - Click the green checkmark to accept the entry.
  - Don't close the table layout window.
  - Using the syntax pay_per_period * 12, create a computed field, named c_SalaryRecalc, to recalculate the salary for each employee.
  - Next to the original salary field, add the c_SalaryRecalc and c_SalaryVariance fields to your view.
  - What is the total variance? (TOTAL command).
  - For a more detailed breakdown of the variance, you can run the STATISTICS command on the c_SalaryVariance field.
  - Notice how many of the variances are for only 4 cents?
  - Filter to exclude variances +/- 5 cents using the filter c_SalaryVariance > .05 OR c_SalaryVariance < -.05

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Conditional Computed Fields

- When different calculations need to be applied based on different conditions within the file, one expression, known as a conditional computed field, can be created. In a conditional computed field, values are calculated conditionally.
- Note:
  - A computed field must be named and always saved.
- In a conditional computed field, different values are assigned when a specified condition is met.
- Every conditional computed field has a **default value** which is the value that is assigned if none of the conditions are met.

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Conditional Computed Fields

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Functions

- Functions are used to apply calculations for a wide variety of purposes.

Function	Purpose	Example		
		Value	Syntax	Value after function applied
PROPER( )	Changes strings to proper (sentence) case.	Carmen	PROPER(first_name)	Carmen
UPPER( )	Changes strings to upper case.	Carmen	UPPER(first_name)	CARMEN
LOWER( )	Changes strings to lower case.	Carmen	LOWER(first_name)	carmen
DEC( )	Determines the number of decimal places that values are rounded to.	57000.053	DEC(salary, 0)	57000
			DEC(salary, 2)	57000.05

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Between

Expression	Field Type	Result
BETWEEN(Posting_Date , `20161001` , `20161231`)	Datetime	Filters transactions for Q4 2016
BETWEEN(location , "02" , "05")	Character	Filters locations from 02 to 05 (inclusive)
BETWEEN(Invoice_Amt , 5000 , 10000)	Numeric	Filters amounts from 5000 to 10000 (inclusive)

```
BETWEEN(value, min , max)
```

where:

Parameter	Description	Example
value	The field, expression, or literal value to test.	InvoiceDate
min	The minimum value of the range.	`20160101`
max	The maximum value of the range.	`20161231`

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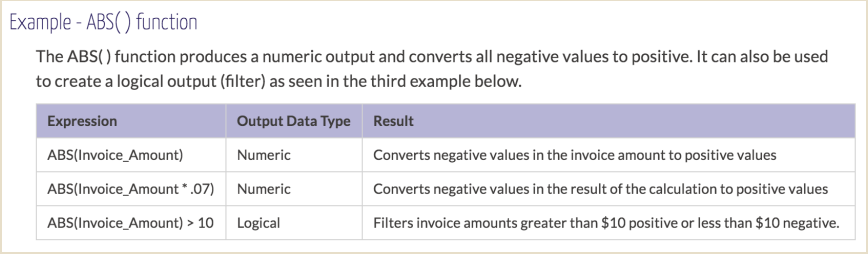
Between



Example - ABS( ) function

The ABS( ) function produces a numeric output and converts all negative values to positive. It can also be used to create a logical output (filter) as seen in the third example below.

Expression	Output Data Type	Result
ABS(Invoice_Amount)	Numeric	Converts negative values in the invoice amount to positive values
ABS(Invoice_Amount * .07)	Numeric	Converts negative values in the result of the calculation to positive values
ABS(Invoice_Amount) > 10	Logical	Filters invoice amounts greater than $10 positive or less than $10 negative.

- To learn more about a specific function, select Help > Contents and enter the function name.
- Can be accessed from the function list, on the right side of the expression builder.
- Can be sub-listed into one of eight categories:
  - all, bit/char, conversion, date & time
  - financial, logical, math
  - miscellaneous, and string
- By default, the Paste Parameters check-box is checked, meaning that

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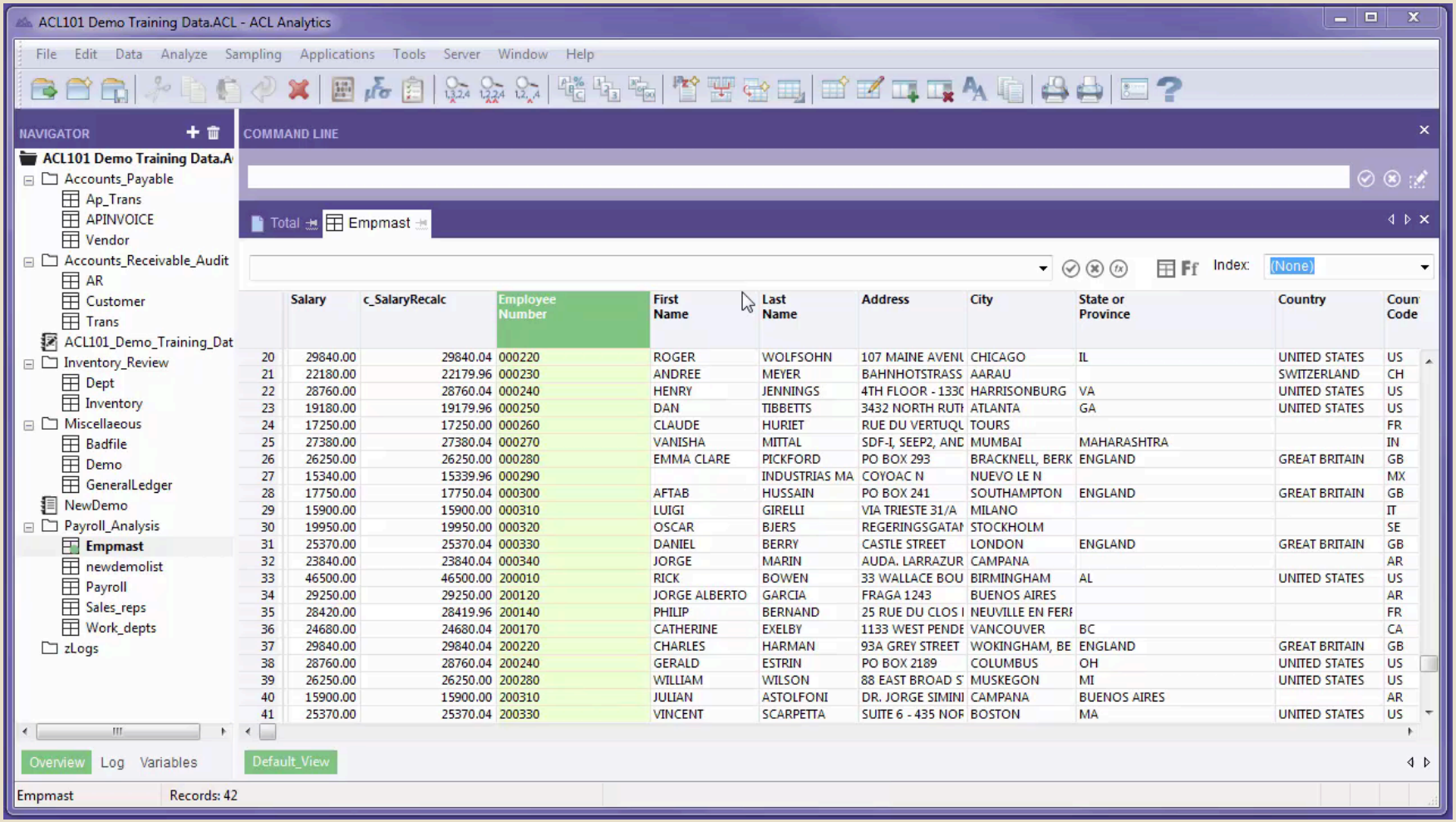
Computed Field – YEAR() Function



	Salary	c_SalaryRecalc	Employee Number	First Name	Last Name	Address	City	State or Province	Country	Coun Code
20	29840.00	29840.04	000220	ROGER	WOLFSOHN	107 MAINE AVENU	CHICAGO	IL	UNITED STATES	US
21	22180.00	22179.96	000230	ANDREE	MEYER	BAHNHOTSTRASS	AARAU		SWITZERLAND	CH
22	28760.00	28760.04	000240	HENRY	JENNINGS	4TH FLOOR - 133(	HARRISONBURG	VA	UNITED STATES	US
23	19180.00	19179.96	000250	DAN	TIBBETTS	3432 NORTH RUTH	ATLANTA	GA	UNITED STATES	US
24	17250.00	17250.00	000260	CLAUDE	HURIET	RUE DU VERTUQU	TOURS			FR
25	27380.00	27380.04	000270	VANISHA	MITTAL	SDF-I, SEEP2, AND	MUMBAI	MAHARASHTRA		IN
26	26250.00	26250.00	000280	EMMA CLARE	PICKFORD	PO BOX 293	BRACKNELL, BERK	ENGLAND	GREAT BRITAIN	GB
27	15340.00	15339.96	000290		INDUSTRIAS MA	COYOAC N	NUEVO LE N			MX
28	17750.00	17750.04	000300	AFTAB	HUSSAIN	PO BOX 241	SOUTHAMPTON	ENGLAND	GREAT BRITAIN	GB
29	15900.00	15900.00	000310	LUIGI	GIRELLI	VIA TRIESTE 31/A	MILANO			IT
30	19950.00	19950.00	000320	OSCAR	BJERS	REGERINGSGATAN	STOCKHOLM			SE
31	25370.00	25370.04	000330	DANIEL	BERRY	CASTLE STREET	LONDON	ENGLAND	GREAT BRITAIN	GB
32	23840.00	23840.04	000340	JORGE	MARIN	AUDA. LARRAZUR	CAMPANA			AR
33	46500.00	46500.00	200010	RICK	BOWEN	33 WALLACE BOU	BIRMINGHAM	AL	UNITED STATES	US
34	29250.00	29250.00	200120	JORGE ALBERTO	GARCIA	FRAGA 1243	BUENOS AIRES			AR
35	28420.00	28419.96	200140	PHILIP	BERNAND	25 RUE DU CLOS I	NEUVILLE EN FERI			FR
36	24680.00	24680.04	200170	CATHERINE	EXELBY	1133 WEST PENDE	VANCOUVER	BC		CA
37	29840.00	29840.04	200220	CHARLES	HARMAN	93A GREY STREET	WOKINGHAM, BE	ENGLAND	GREAT BRITAIN	GB
38	28760.00	28760.04	200240	GERALD	ESTRIN	PO BOX 2189	COLUMBUS	OH	UNITED STATES	US
39	26250.00	26250.00	200280	WILLIAM	WILSON	88 EAST BROAD S	MUSKEGON	MI	UNITED STATES	US
40	15900.00	15900.00	200310	JULIAN	ASTOLFONI	DR. JORGE SIMINI	CAMPANA	BUENOS AIRES		AR
41	25370.00	25370.04	200330	VINCENT	SCARPETTA	SUITE 6 - 435 NOR	BOSTON	MA	UNITED STATES	US

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Class Activity Computed Field

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YEAR() Function

- Create a computed field, **c_HireYear**, that calculates the year that each employee was hired in.
  - In the **Empmast** table, right-click in the View and select **Add columns**.
  - Click **Expr...**
  - In the Save As text box, enter **c_HireYear.**
  - In the Functions list, scroll down to the **YEAR( )** function and double-click on it so that it appears in the Expression text box.
  - Double-click on the 'date/datetime' parameter so that it is highlighted.
  - In the **Available Fields** list, scroll down to **hiredate** and double-click on it so that it replaces 'date/datetime' in the Expression text box.
  - Click **Verify** to confirm that the syntax is valid and then click **OK** to save the field and close the Expression Builder.
  - In the **Add Columns** dialog, click **OK.**

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ABS() Function

- Since pay cheques are issued monthly, the pay_per_period for each employee should equal 1/12th of their salary.
  - Click on the Edit View Filter button at the top of the view.
  - Enter the expression: ABS(c_SalaryVariance) > .05.
  - Click OK

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Fixed Point Arithmetic (Rounding)

- When calculating multiplication or division, ACL Analytics uses fixed-

Expression	Largest # of decimal places	Result (value)	Reasoning
4 + 5.0	1	9.0	1 decimal place (5.0)
1.1 * 1.1	1	1.2	1 decimal place
6 * 2.000	3	12.000	3 decimal places (2.000)
6.12 * 10.1	2	61.81	= (6.12 * 10.1) = 61.81 (rounded to two decimal places from 61.812)

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Questions?

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