

Welcome



Improving Forecast Accuracy: Fine-Tuning Workload Predictions

Presented by:

THE CALL
CeNTER
SCHOOL



About Maggie



Maggie Klenke is a Co-Founder of *The Call Center School* – a leading US specialist in professional development of call centre professionals. Maggie heads up the company's consulting and professional service division, overseeing a wide range of projects related to call centre operations and workforce planning.

Maggie is a popular speaker at industry conferences and association meetings and she writes frequently for industry publications with articles and blogs appearing regularly across the industry. She is the author of *Business School Essentials for Call centre Leaders*. Along with Penny Reynolds, she has also co-authored the five textbooks used by the University of Phoenix call centre management program, as well as the popular *Call centre Staffing – The Complete, Practical Guide to Workforce Management*.

Maggie has over 30 years experience in call centre operations from the perspective of an end-user, vendor, consultant, and teacher. She was among the first in the industry to earn CIAC professional certification as a Certified Call centre Management Consultant.

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Calculating Forecast Accuracy

Ways to Measure Accuracy:

- Percent Difference
- Standard Deviation
- Correlation Coefficients



Calculating Forecast Accuracy

Which is better?

	% Difference		% Difference
Monday	1.9%		- 1.1%
Tuesday	3.6%		+ 28.6%
Wednesday	4.7%		+ 9.3%
Thursday	4%		- 11.5%
Friday	4.9%		- 21.6%
Saturday	7.3%		- 3.4%
Total	3.9%		- 0.7%

Importance of Interval Measured

- How can the measurement help improve accuracy?
 - Monthly or weekly analysis not very helpful
 - Daily better
 - Half-hourly best
- Look for patterns
 - Look for consistency in results and focus on those time periods with biggest problems
 - Largest variations occur on certain day? Specific hours?
- Excel Pivot Tables are excellent tools for analysis of large amounts of data

Calculating Variability

	Forecast Volume	Actual Volume	% Difference
Monday	3533	3494	- 1 %
Tuesday	2455	3156	+ 29 %
Wednesday	2611	2854	+ 9 %
Thursday	2990	2647	- 11 %
Friday	2935	2301	- 22 %
Saturday	1028	993	- 3 %
Total	15,552	15,445	<1%
		Average =	0%
		Standard Dev =	17.53%

What does a 17% variation from forecast to actual do to your operation?

Calculating Forecast Accuracy

Correlation Coefficients

A numerical value that identifies the strength of a relationship between variables.

The higher the correlation coefficient, the better the match or "fit" of the model.

The correlation function in Excel is:

`CORREL(array1, array2)`

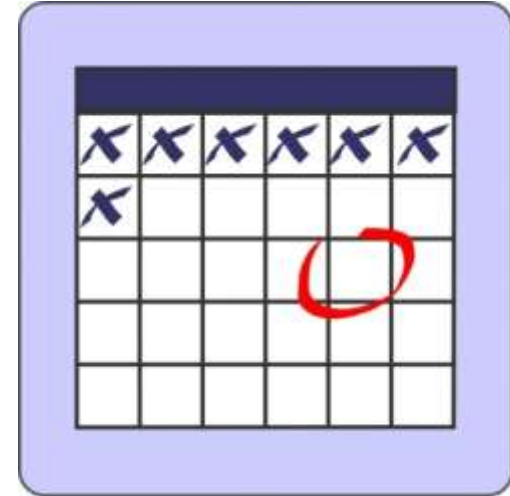
Where array1 and array2 are cell ranges of equal lengths.

Measures the match of the patterns only.

Cycle Forecasting – aka Special Events

Two Primary Components

- Volume of work
- Distribution across cycle



Regression Analysis – How Much Change

A forecasting approach where future events are dependent upon an event or variable in addition to normal historical influences

Catalogues Mailed	Call Volume
123,000	72,000
135,000	85,000

Regression Analysis

- Catalogue drops, billing dates or other mailings
 - Mailings = independent variable
 - Call volume = dependent variable
- Impact spreads over several days or weeks
 - Pattern can be identified.
 - Date driven vs. day of week.
- Separate “normal” from variable

Catalogue Mailing and Call Volumes

Month	Incremental Call Volume	No. of Catalogues
September	72,000	123,000
October	85,000	135,000
November	92,000	140,000
December	101,000	155,000
January	54,000	86,000
February	55,000	77,000
March	78,000	98,000
April	105,000	165,000
May	82,000	123,000
June	85,000	132,000

Excel Example

Click down arrow to see function choices.

The screenshot shows Microsoft Excel with the following data and formula:

Call Volume (dependent)	Catalogs (Independent)
72000	123000
85000	135000
92000	140000
101000	155000
54000	86000
55000	77000
78000	98000
105000	165000
82000	123000
85000	132000

Formula in cell B15: $=\text{SLOPE}(A4:A13,B4:B13)$

Result in cell B15: 0.565340602

The toolbar shows the function button (Σ) circled in red. Red arrows point from this button to the formula bar and the result cell.

Applying the Regression Analysis

- Using Excel and the function “slope”, the relationship between the Catalogue mailings and calls shows that there will be 0.565 additional calls for each Catalogue mailed.
- If the base historical forecast was 11,137 calls, the new forecast for a period when 90,000 Catalogues would be mailed is:
$$11,137 + (0.565 \times 90,000) = 61,987 \text{ calls}$$

Regression versus Correlation Coefficient

- Regression identifies how many
- Correlation coefficients identifies distribution pattern
- Analyze history for similar incidents
 - Analyze the patterns
 - Look for good pattern match

Identifying Patterns

Correlation Coefficients

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The higher the correlation coefficient, the better the match or "fit" of the model.

The correlation function in Excel is:

`CORREL(array1, array2)`

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Billing Cycle Forecasts Example

Identifiable Cycles:

- Bills mailed
 - 5th of the month
 - Any day except Sunday
- Noticeable spikes in call volume
- Effect lasts for 5-6 days after mail received
- Separate new from normal volume



Billing Cycle Forecasts

Quantifying Cyclical Forecasting Data

- Several months of history
- Start point (5th of the month) not always the same day of the week
- Adjust out data for normal patterns
- Discard anomalies

Billing Cycle Example

Assembling the Data

- 6-day work week
- Started with first 4 months of year
- Expand history if correlation found
- Focusing on the 5-6 days after the mail arrives



Data Example

- See next 4 slides for data
- 5th day of month
 - January = Saturday
 - February = Tuesday
 - March = Saturday
 - April = Tuesday
- 2 days from mailing to receipt

January Data

Date	Day	Actual Calls	Normal Calls	Incremental Calls
5 Jan	Sat	2703	2700	n/a
6 Jan	Sun	0	0	n/a
7 Jan	Mon	6875	5289	1586
8 Jan	Tue	5754	4875	879
9 Jan	Wed	5398	4750	648
10 Jan	Thu	4802	4523	279
11 Jan	Fri	4200	3898	302
12 Jan	Sat	3109	2700	409

February Data

Date	Day	Actual Calls	Normal Calls	Incremental Calls
5 Feb	Tue	4887	4875	n/a
6 Feb	Wed	4734	4750	n/a
7 Feb	Thu	5904	4523	1381
8 Feb	Fri	5387	3898	1489
9 Feb	Sat	3156	2700	456
10 Feb	Sun	0	0	0
11 Feb	Mon	5869	5289	580
12 Feb	Tue	5076	4875	201

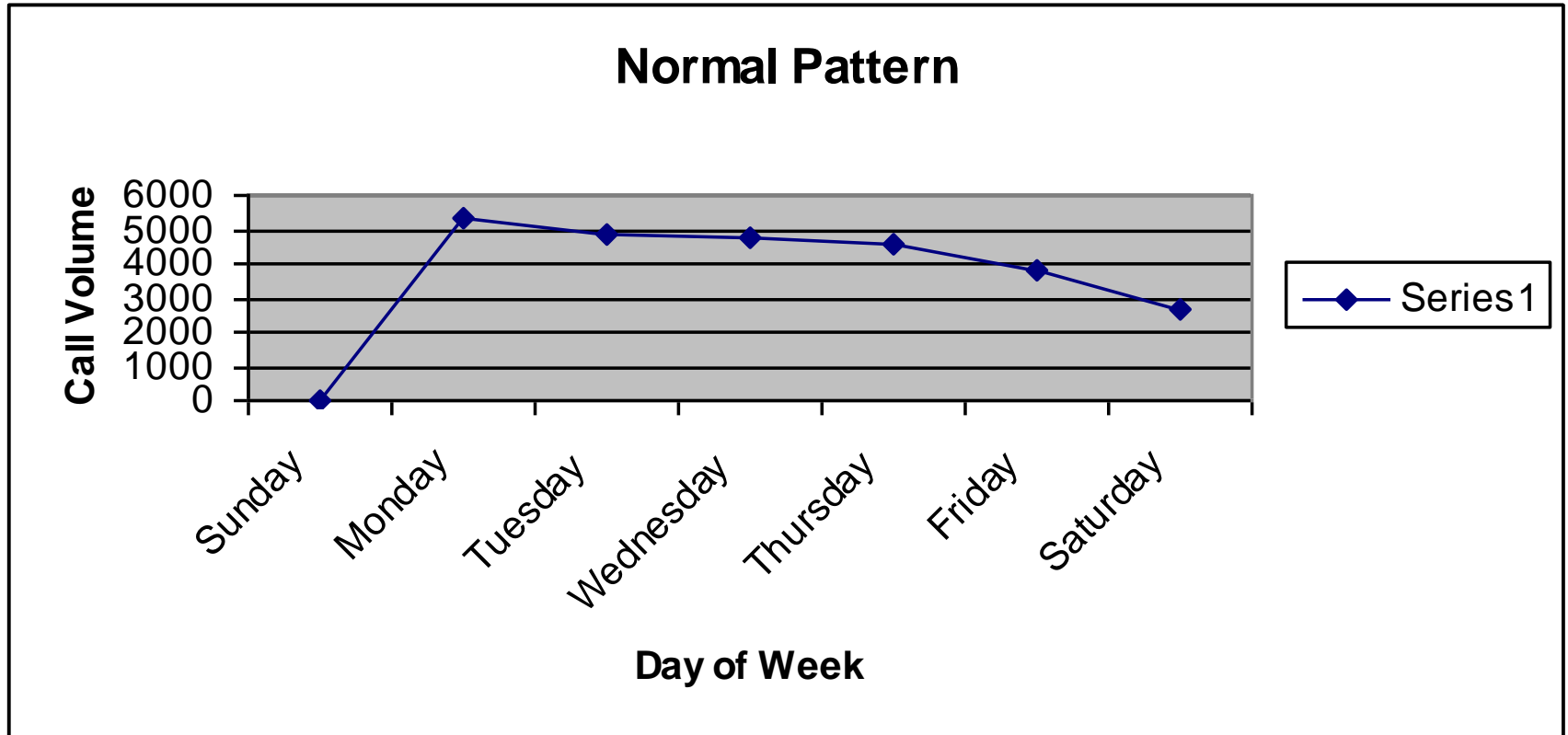
March Data

Date	Day	Actual Calls	Normal Calls	Incremental Calls
5 Mar	Sat	2703	2700	n/a
6 Mar	Sun	0	0	n/a
7 Mar	Mon	6843	5298	1554
8 Mar	Tue	5590	4875	715
9 Mar	Wed	5402	4750	652
10 Mar	Thu	4760	4523	237
11 Mar	Fri	4208	3898	310
12 Mar	Sat	3098	2700	398

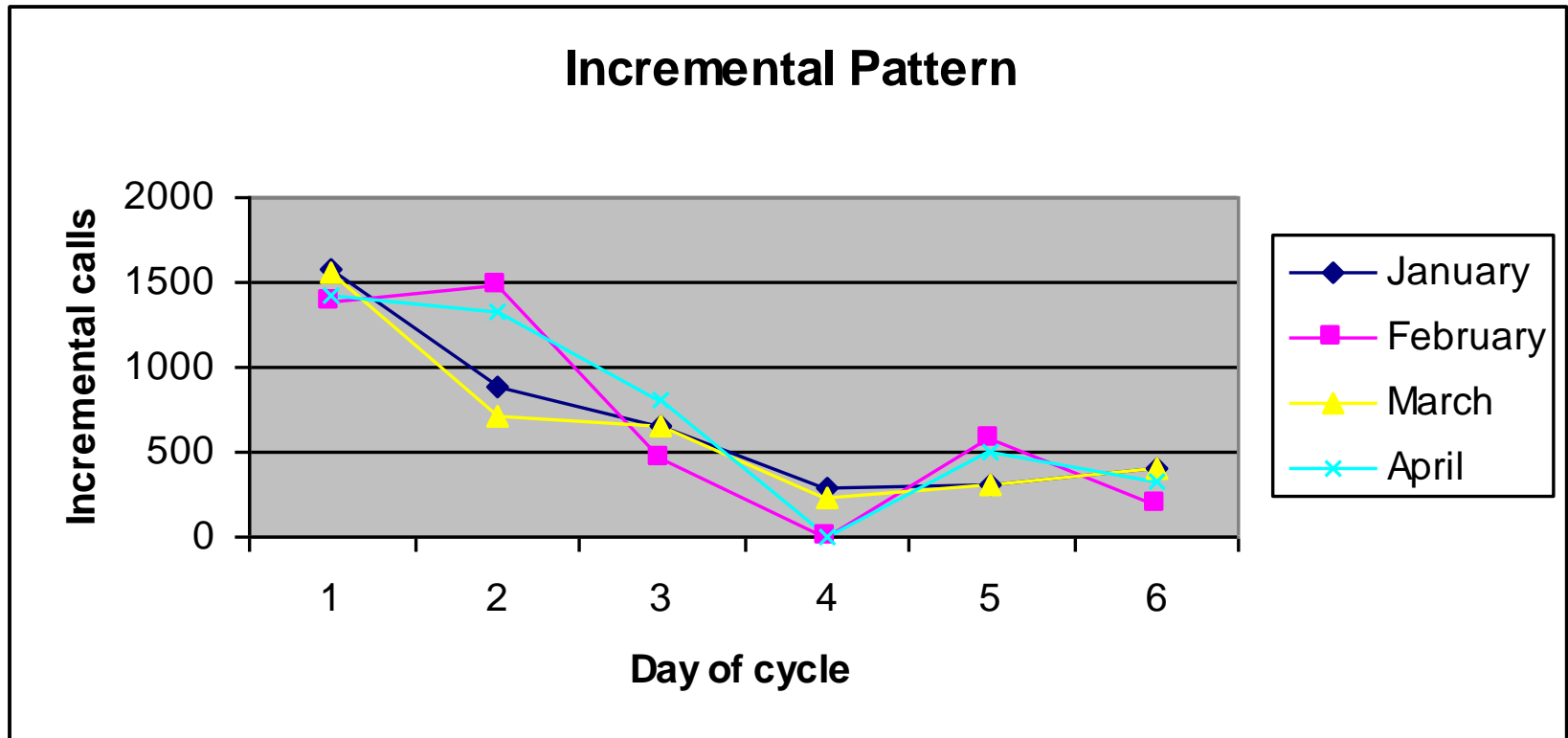
April Data

Date	Day	Actual Calls	Normal Calls	Incremental CV
5 Apr	Tue	4887	4875	n/a
6 Apr	Wed	4734	4550	n/a
7 Apr	Thu	5943	4523	1420
8 Apr	Fri	5217	3898	1319
9 Apr	Sat	3509	2700	809
10 Apr	Sun	0	0	0
11 Apr	Mon	5780	5289	491
12 Apr	Tue	5209	4875	334

Graph of Normal Week Distribution



4 Months of Incremental Call Volume



Using Excel

1. Enter the data in worksheet as shown
2. Choose any open cell to perform the analysis
3. Go to arrow on right of "AutoSum" symbol
4. Select "more functions"
5. Choose "Correl" from the list
6. Select data from one month for Array 1 and the other month for Array 2 - Make sure the number of cells in Array 1 and 2 are equal
7. Click OK
8. Output is correlation coefficient – higher number = strong correlation
9. Correlation coefficient of 1.0 equals a perfect match



Example January and February Data

5 Jan	Saturday	0	5 Feb	Tuesday	0
6 Jan	Sunday	0	6 Feb	Wednesday	0
7 Jan	Monday	1586	7 Feb	Thursday	1381
8 Jan	Tuesday	879	8 Feb	Friday	1489
9 Jan	Wednesday	648	9 Feb	Saturday	456
10 Jan	Thursday	279	10 Feb	Sunday	0
11 Jan	Friday	302	11 Feb	Monday	580
12 Jan	Saturday	409	12 Feb	Tuesday	201

- Using any open cell, select or type =CORREL(
- Click on first array of data – January difference 1586 – 409
- Insert comma and click on second array of data – February difference 1381-201
- If typing manually, type) and the calculation will be performed

Billing Example Correlation Analysis

Each set of months was analyzed

- Jan – Feb .811069
- Jan – Mar .991872
- Jan – Apr .880543
- Feb – Mar .752364
- Feb – Apr .955501
- Mar – Apr .842633



Stronger relationship between months that have
5th on same day of week

- Jan – Mar
- Feb - Apr

Next Steps

1. Gather more history – same start day
2. Determine pattern of incremental call volume
 - based on average
 - Compute percent of added calls (by day of week)
3. Predict the total added call volume using regression analysis
4. Distribute the total added across the days of the cycle
5. Add the incremental call volume to the normal expected volume

Day of Week Distribution Jan-Mar

Day	Jan. CV	Mar. CV	Avg. CV	Day's %
Mon	1588	1554	1571	.394
Tue	879	715	797	.200
Wed	648	652	650	.163
Thu	279	237	258	.065
Fri	302	310	306	.077
Sat	409	398	403	.101
Total	4107	3866	3986	1.00

Note: Best to use at least 6-8 data elements for accuracy.

Total New Forecast - Activity

*** 4950 additional calls expected**

Day	Normal CV	Day's %	Added CV*	Total Forecast
Mon	5289	.394	1951	7240
Tue	4875	.200		
Wed	4750	.163		
Thu	4523	.065		
Fri	3898	.077		
Sat	2700	.101		
		1.00		

Total New Forecast - Activity

*** 4950 additional calls expected**

Day	Normal CV	Day's %	Added CV*	Total Forecast
Mon	5289	.394	1951	7240
Tue	4875	.200	989	5864
Wed	4750	.163	807	5557
Thu	4523	.065	320	4843
Fri	3898	.077	380	4278
Sat	2700	.101	501	3201
		1.00		

Other Applications

- Marketing
- AHT
- Weather
- New releases/products
- Any repeated event



Track Business Drivers & Events

Keep a daily log:

- Track volume and AHT forecast versus actual.
- Identify reasons for unusual volume changes.
- Note the weather and its affect on workload.
- Identify reasons for AHT changes.
- Identify reasons for unusual staff shrinkage.
- Use the log to help predict future periods.

Business Drivers and Impact Analysis Matrix

- Name of the business driver
- Call volume impact
- AHT impact
- Pattern impact
- Length of impact
- Mechanism to predict
- Prevention technique (if appropriate)



Thank You!

Thank you for your participation today.



**Understanding your cycles can improve
your forecasts a great deal!**