




URBAN SCIENCE®

SUCCESS WITH THE TSP - IMPROVE YOUR PROJECT ESTIMATIONS WITH STATISTICAL ANALYSIS TOOLS

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“There are lies, there are damn lies, and then there are statistics...”

– Unknown, though popularized by Mark Twain



PURPOSE OF THIS PRESENTATION

Learning



- Learn more about a set of three estimation tools that can improve estimation accuracy

Application



- Understand how to use these three tools individually or in concert

Benefits



- Discuss the concrete benefits to capturing accurate time and size data

Reminders



- Discover important reminders when dealing with statistics

THREE TOOLS WE WILL DISCUSS

Proxy Size Analysis

- Creates Relative Size tables for team work products
- Assesses the sample data's fit to a normal distribution
- Measures the the size and effort correlation
- Allows examination of the data for outliers

PROBE in Excel

- A spreadsheet that mimics the **PROxy Based Estimation** tool ("A" method only) from the PSPSM* methodology to potentially improve estimates

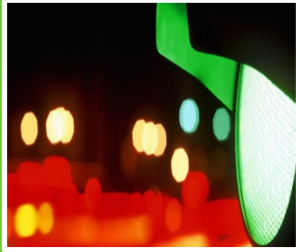
**PSPSM is a service mark of Carnegie Mellon University*

Multi-Language Estimation

- Calculate an effort estimate for components that are written with multiple coding languages



WHAT'S IN IT FOR YOU?



Faster Launches

- Having sound size estimations gets you through Launch Meetings 3 (Conceptual Design/Strategy) and 4 (Overall Plan & Schedule) in less time



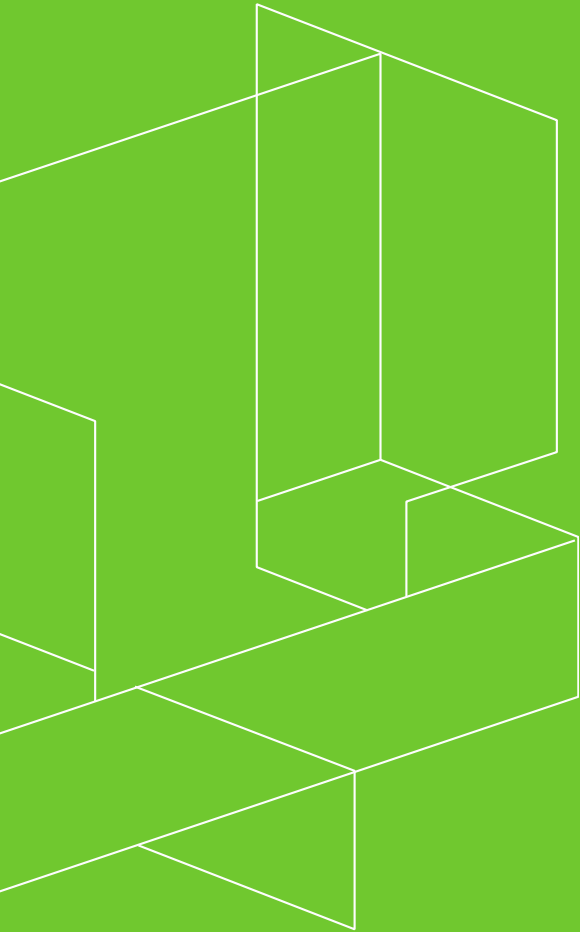
Improved Risk Assessment

- In Launch Meeting 7 (Risk Analysis), focus your time on the work products where uncertainty has been clearly established



Greater overall schedule accuracy

- A project based on a statistically and historically based estimation methodology has a much greater chance of success without overtime and weekend work!



THE ESTIMATION TOOLS: PROXY SIZE ANALYSIS

OVERVIEW

- The Proxy Size Analysis tool allows a team to:
 - Maintain data for a multitude of component types
 - Assess the fitness of the data for planning
 - Allows rapid determination of a productivity rates and proxy sizing in Launch Meetings #3 and #4 (Strategy and Overall Project Plan Meetings)
- The statistics generate predictions not guarantees!



- Tool is only as good as the data it is provided
- You need:
 - Discipline
 - Patience



FIBONACCI SEQUENCE



- While this tactic is certainly better than nothing for initial planning, the actuals often show a different reality

- One frequent tactic used in initial launches with no historical data is for the TSPSM* coaches to start with a Fibonacci sequence to help guide relative sizing for creating the initial estimates:

M

1	2	3	5	8	13	21	34	55	89
---	---	---	---	---	----	----	----	----	----

- The team reaches a consensus on what value to assign to “Medium”
- The team then creates relative sizes for the other values from there (LOC in this example)

VS	S	M	L	VL
3	5	8	13	21
131	219	350	569	919

**TSPSM is a service mark of Carnegie Mellon University*

WORK PRODUCTS

- Different types of work products, even in the same category such as requirements documents, code, or test cases, may prove to have different relative sizes computed at different intervals
- Work products, even of the same category, may need to be measured in different terms to achieve a strong correlation
- Knowing how strong your relative sizing is and the strength of the correlation between size and effort will assist in assessing project risk and allow for contingency time based on actual data rather than a base bucket of hours or a percentage

So let's take a look at the Proxy Size Analysis tool and see what it can do for us...

PROXY SIZE ANALYSIS – SUMMARY PAGE

- This tool consists of two parts, the front page, shown on this slide, with as many category tabs as your team deems necessary for the work it performs

Name	VS	S	M	L	VL	Rate/hr	Proxy Size Type
Requirement Doc	15.88	57.87	210.94	768.86	2802.44	35.84	Lines of Text
Research Doc	41.40	88.43	188.90	403.51	861.96	13.30	Pages
Detailed Design	72.11	137.80	263.33	503.21	961.60	20.76	Lines of Text
Detailed Design in Pages	7.81	10.44	13.96	18.66	24.95	0.59	Pages
Architecture Code	118.22	215.45	392.64	715.55	1304.04	29.07	LOC
RefArch Doc	231.53	326.19	459.56	647.45	912.17	46.01	Lines of Text
HLD	126.79	206.54	336.44	548.05	892.75	12.66	Lines of Text
Instructional Document	7.36	22.33	67.76	205.68	624.31	28.98	LOT
Production Code	21.00	21.00	21.00	21.00	21.00	75.70	LOC

Proxy Tables Requirement Doc Research Doc Detailed Design Detailed Design in Pages Architecture

Tabs for every work product type types of Code
have different relative
sizes and production rates

- Items of note...
- Now let's look at one of the supporting pages...

PROXY SIZE ANALYSIS – DETAIL PAGE

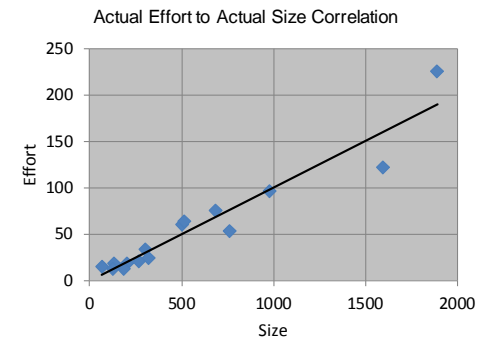
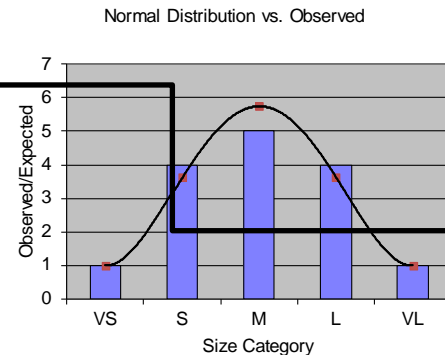
- This is one of the supporting pages and we'll highlight each section of the page in its own slide

Section for comparing
Section for entering
Actual Sizes and Actual
Effort
outliers

Instructions
Enter work in
column name
Lines of Code

Name	Actual Size (LOC)	Actual Effort (HRS)	RSV	Rate (Size/Hr)
Total	8542	853.4		10.01
abc	202	18.3	S	11.04
def	684	75.3	L	9.08
ghi	135	18.2	S	7.42
jkl	270	20.4	M	13.24
mno	305	33.6	M	9.08
pqr	318	24.7	M	12.87
stu	186	13.1	S	14.20
vwx	1892	225.6	VL	8.39
yz1	763	52.8	L	14.45
23f	1598	122.4	L	13.06
23b	65	15	VS	4.33
79X	504	60.6	M	8.32
30c	515	63.4	M	8.12
18x	980	97	L	10.10
gg3	125	13	S	9.62

Count	MidPoints	Size	Observed	Expected
15	54.5	VS	1	1.00
	143.3	S	4	3.63
	376.5	M	5	5.74
	989.5	L	4	3.63
	2600.6	VL	1	1.00
		χ^2 Value		0.979



Correlation Values	
R ² Value	0.92
Significance	0.00


PROXY SIZE ANALYSIS – SAMPLE DATA SECTION

- In this section the name of the item, its actual size and measure, actual effort to produce, and relative size value (RSV) are listed. These values roll up to provide an average productivity rate. This sample data is meant to show a near perfect case for illustrative purposes.

Name	Actual Size (LOC)	Actual Effort (HRS)	RSV	Rate (Size/Hr)
Total	8542	853.4		10.01
abc	202	18.3	S	11.04
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30c	515	63.4	M	8.12
18x	980	97	L	10.10
gg3	125	13	S	9.62



PROXY SIZE ANALYSIS – RELATIVE SIZE AND ANALYSIS

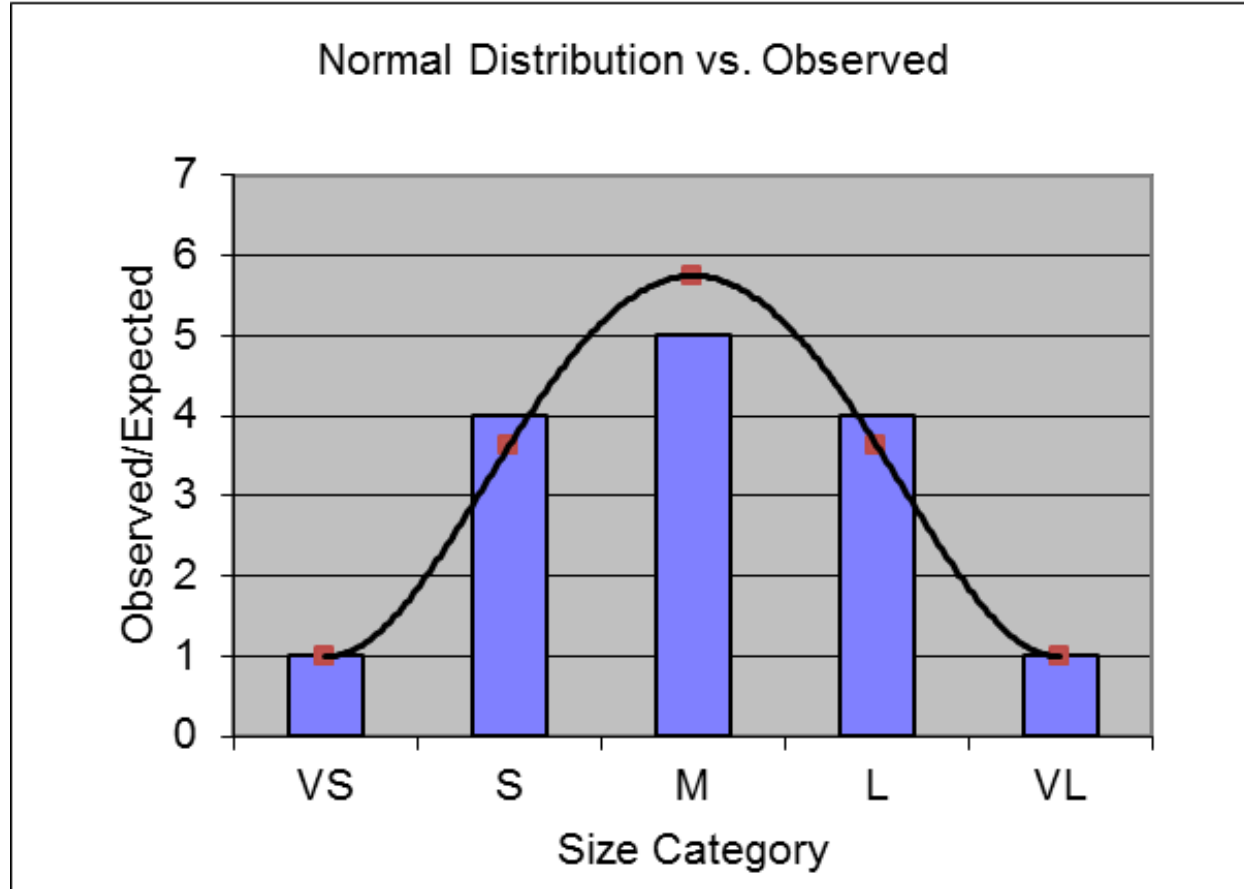
MidPoints	Size	Observed	Expected
54.5	VS	1 	1.00
143.3	S	4 	3.63
376.5	M	5 	5.74
989.5	L	4 	3.63
2600.6	VL	1 	1.00
		χ^2 Value	0.979

PROXY SIZE ANALYSIS – CHI SQUARED TEST

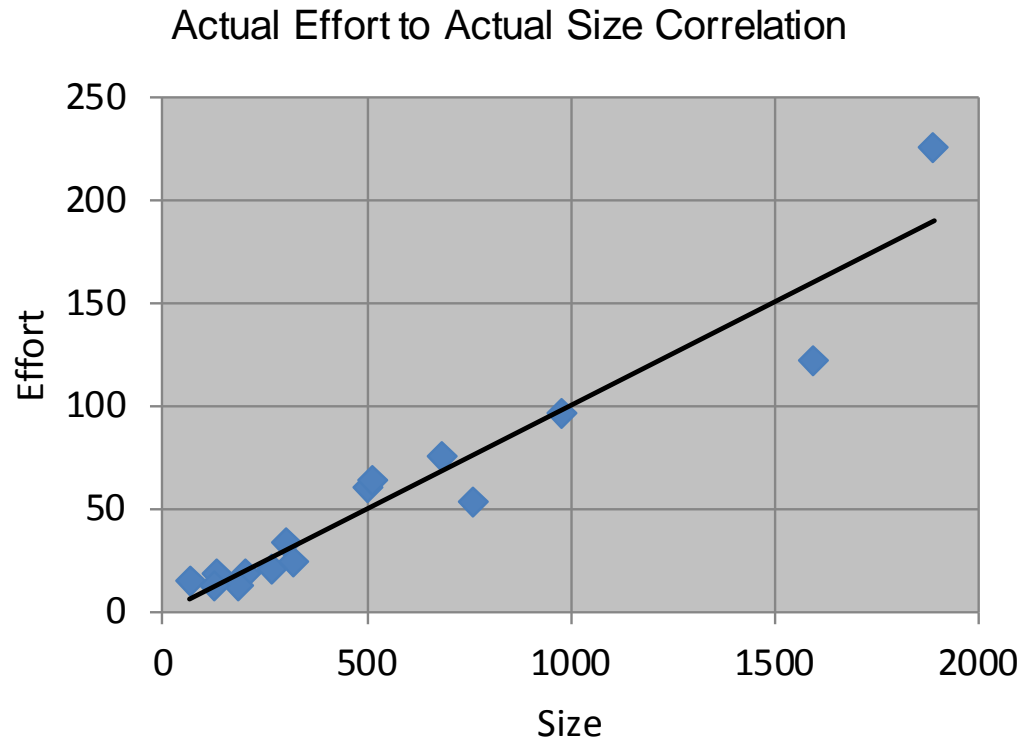
MidPoints	Size	Observed	Expected
54.5	VS	1	1.00
143.3	S	4	3.63
376.5	M	5	5.74
989.5	L	4	3.63
2600.6	VL	1	1.00
		χ^2 Value	0.979

PROXY SIZE ANALYSIS – DISTRIBUTION CURVES

- This chart will assist you to better visualize what the previous table was describing:



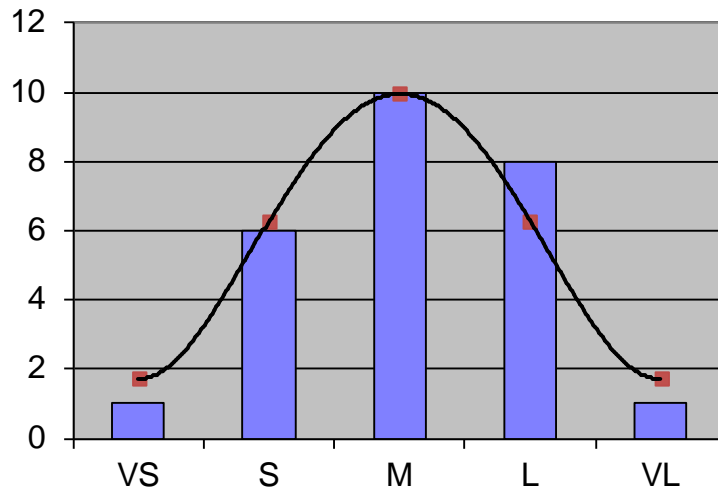
PROXY SIZE ANALYSIS – SIZE/EFFORT CORRELATION



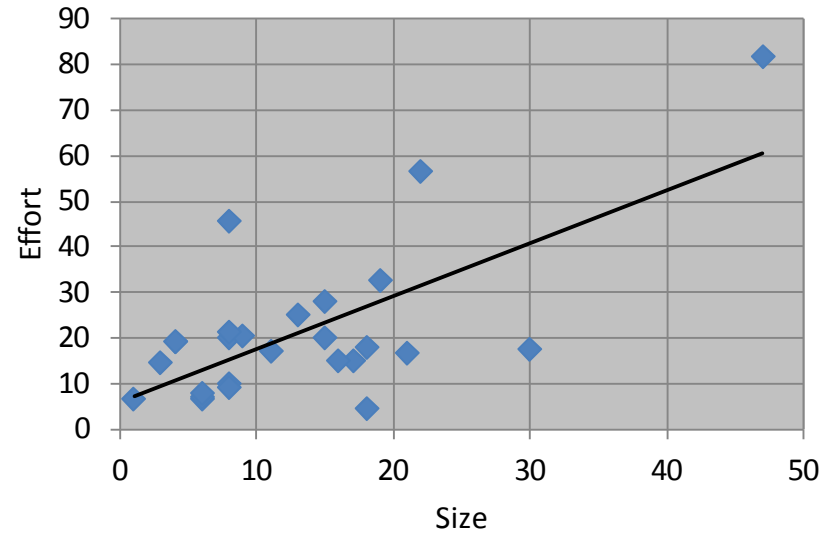
Correlation Values	
R ² Value	0.92
Significance	0.00

PROXY SIZE ANALYSIS – REAL LIFE EXAMPLES

Normal Distribution vs. Observed



Actual Effort to Actual Size Correlation

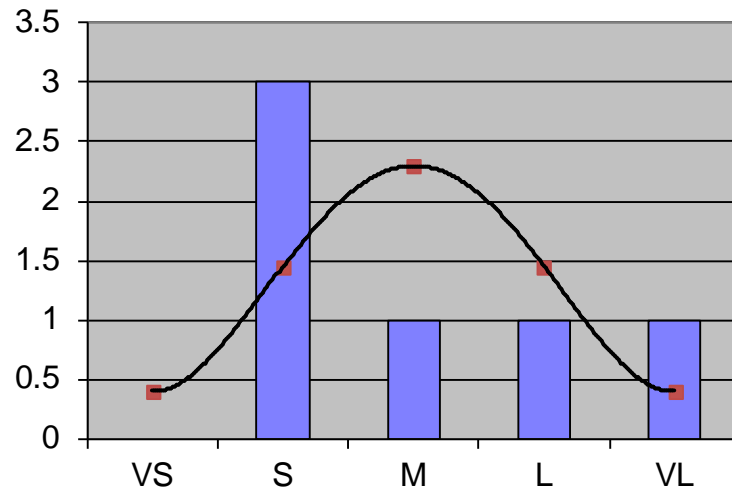


MidPoints	Size	Observed	Expected
2.0	VS	1	1.74
4.5	S	6	6.28
10.0	M	10	9.96
22.5	L	8	6.28
50.3	VL	1	1.74
		χ^2 Value	0.871

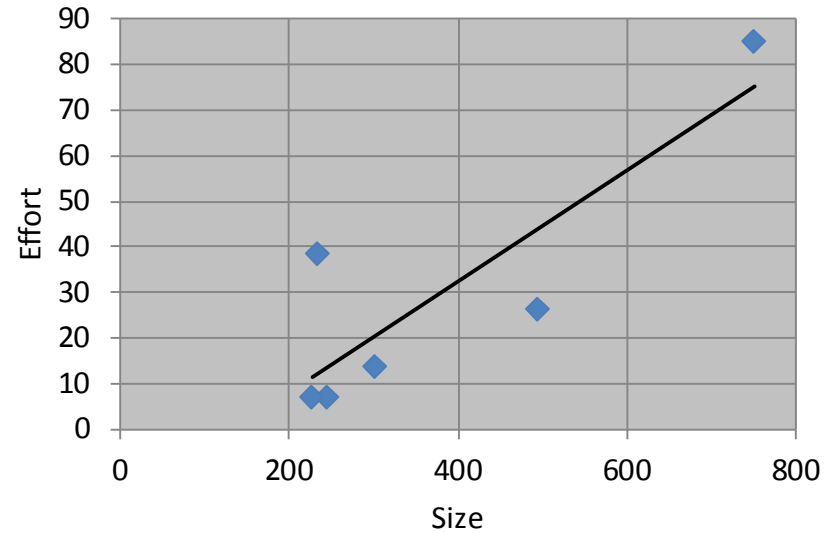
Correlation Values	
R ² Value	0.45
Significance	0.00

PROXY SIZE ANALYSIS – REAL LIFE EXAMPLES

Normal Distribution vs. Observed



Actual Effort to Actual Size Correlation



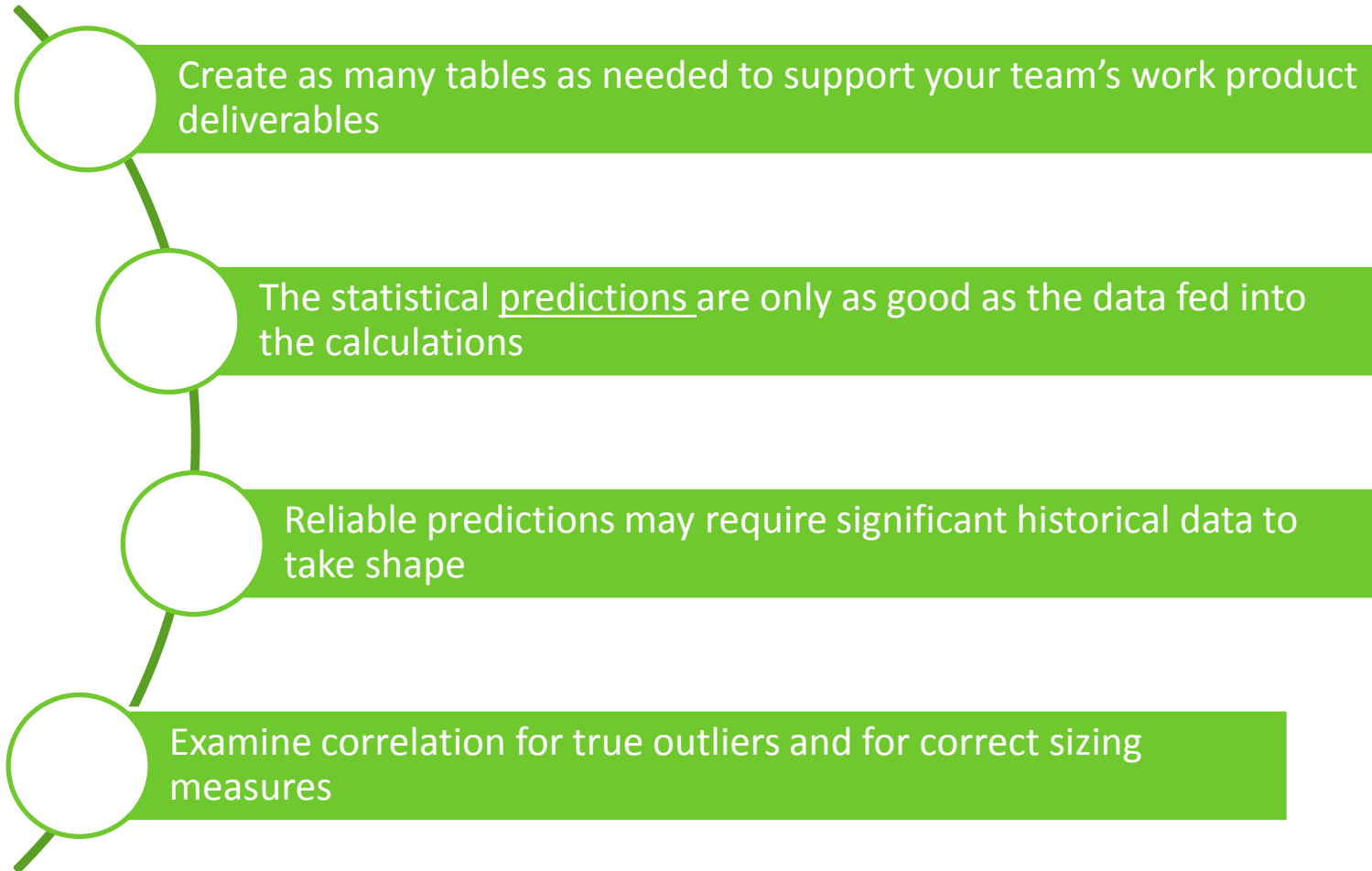
MidPoints	Size	Observed	Expected
126.8	VS	0	0.40
206.5	S	3	1.45
336.4	M	1	2.30
548.0	L	1	1.45
892.7	VL	1	0.40
		χ^2 Value	0.620

Correlation Values	
R ² Value	0.73
Significance	0.03

PROXY SIZE ANALYSIS

- The natural instinct is to remove “outliers” and this tool can help guide the selection process as simply trying to remove Normal Distribution bias could result in a lowering of Size/Effort correlation or vice-versa
- Removing outliers from an analysis sheet requires their movement to another analysis sheet – do the outliers perhaps belong in the same category or separate categories?
- Avoid creating numerous “outlier” tables

PROXY SIZE ANALYSIS – CONCLUSIONS





THE ESTIMATION TOOLS: PROBE IN EXCEL

OVERVIEW - WHAT IS PROBE?

- **PROxy Based Estimation**
- Linear Regression model used to improve estimates based on historical trends
- Corrects for tendencies to over or under estimate work product size or effort
- Our spreadsheet tool only simulates PROBE “A”

OVERVIEW

- Proxy Based Estimation is such a powerful concept that we had to make it as accessible to everyone as possible
- Can improve any size/effort based estimation
- Can further refine degrees of risk present in an estimate to aid in contingency planning
- **The statistics generate predictions not guarantees!**



- Tool is only as good as the data it is provided
- You need:
 - Discipline
 - Patience

So let's take a look at the PROBE in Excel tool and see what it can do for us...

PROBE IN EXCEL

- The spreadsheet consists of three tabs – a data entry tab plus two charts
- This is what the data entry tab looks like:

Program #	Estimated Proxy Size	Actual Added and Modified Size	Actual Development Time	Proxy Size	Sample Size	LOC Estimate		Effort Estimate	
1	135	188	8.8	244	10	R	0.975	R	0.991
2	734	693	71.4			R ²	0.950	R ²	0.982
3	88	137	11.3	Prediction Interval		Significance	0.000	Significance	0.000
4	163	268	21.6			β_0	-20.082	β_0	-2.386
5	142	298	22	68.268%		β_1	1.372	β_1	0.120
6	305	322	31.4			P	315	P	27
7	154	209	18.2			Range	171	Range	9
8	1236	1903	157			UPI (68.268%)	485	UPI (68.268%)	36
9	665	766	71.6			LPI (68.268%)	144	LPI (68.268%)	18
10	1204	1635	142						

- Let's explain what we're looking at...

PROBE IN EXCEL

Enter the requested values in the first three columns

Enter the estimated Proxy Size for the component to be created here

Obtain the statistical analysis of your the Predictive value and the Upper and Lower Prediction Intervals for your work

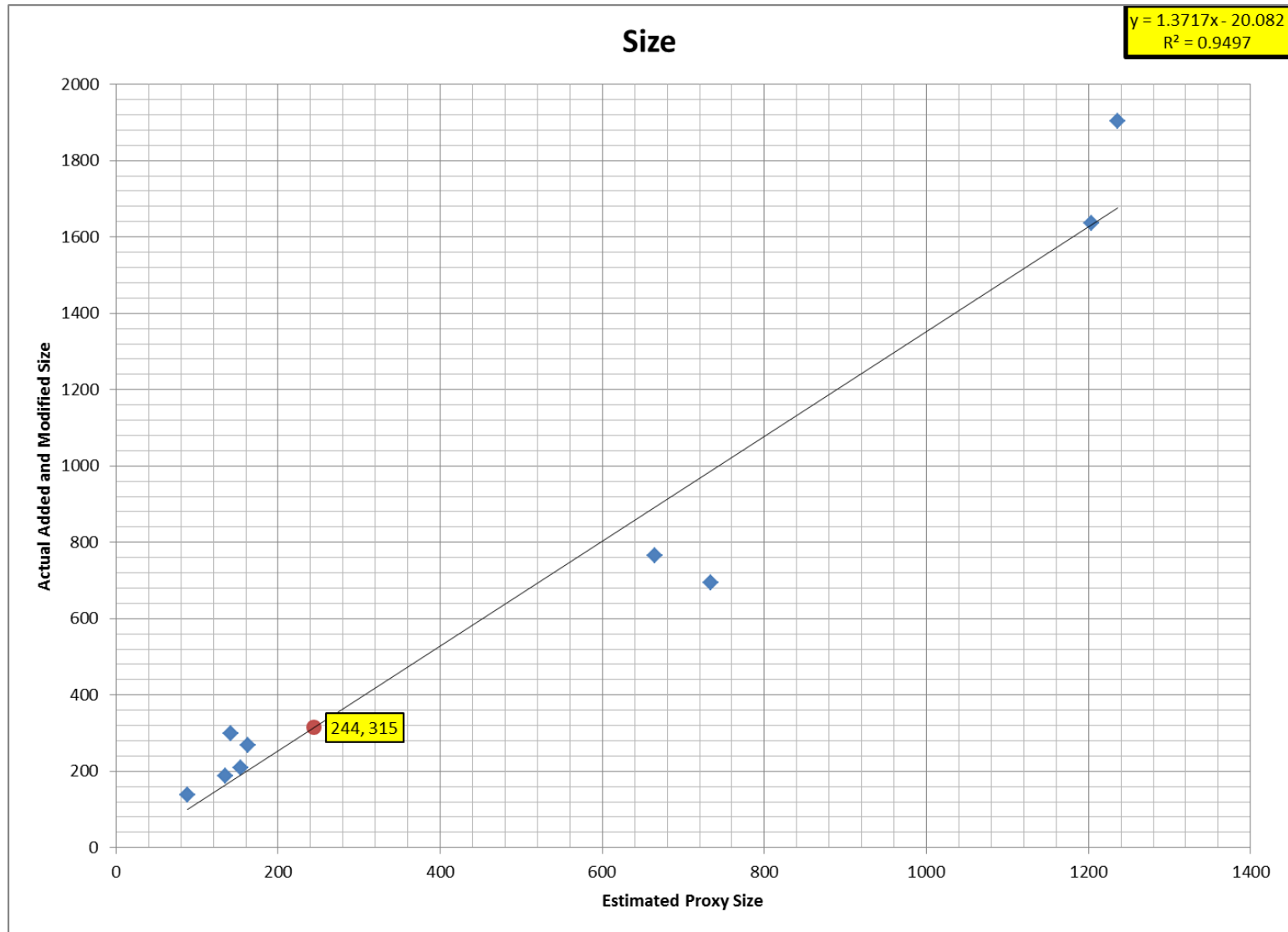
Program #	Estimated Proxy Size	Actual Added and Modified Size	Actual Development Time	Proxy Size	Sample Size	LOC Estimate		Effort Estimate	
1	135	188	8.8	244	10	R	0.975	R	0.991
2	734	693	71.4			R ²	0.950	R ²	0.982
3	88	137	11.3	Prediction		Significance	0.000	Significance	0.000
						β_0	-20.082	β_0	-2.386
						β_1	1.372	β_1	0.120
						P	315	P	27
						Range	171	Range	9
						UPI (68.268%)	485	UPI (68.268%)	36
						LPI (68.268%)	144	LPI (68.268%)	18

The L.P.I. for the Estimates are not limited to positive numbers. With small total sample sizes, or small actual A&M sizes, the LPI could be a negative number (Calling for rejection of the estimate or refinement of the P.I. value)

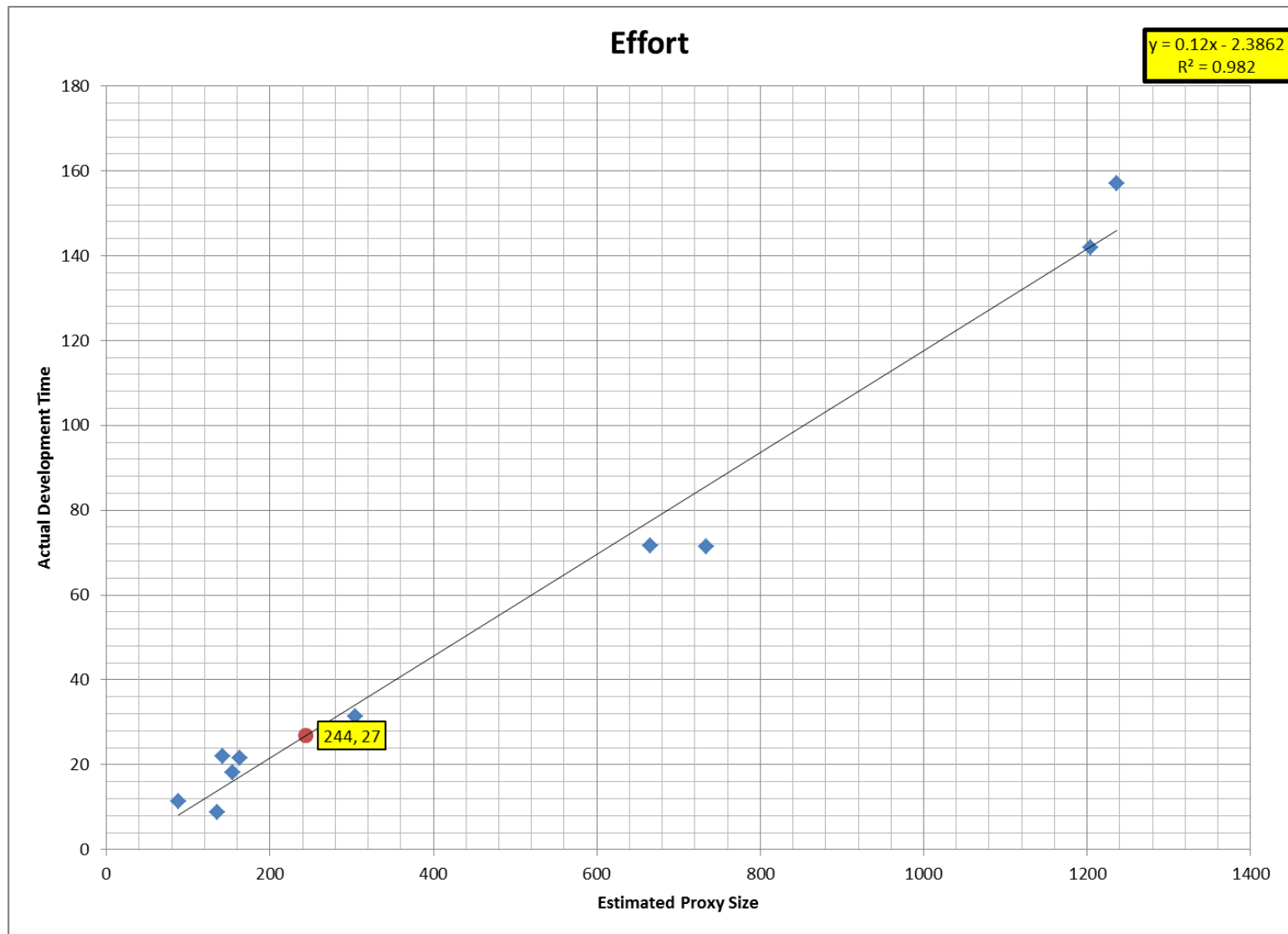
Enter the desired Prediction Interval for this estimate here

The β_0 and β_1 Values describe/define the regression line your historical data creates that your Proxy Size estimate will be evaluated against

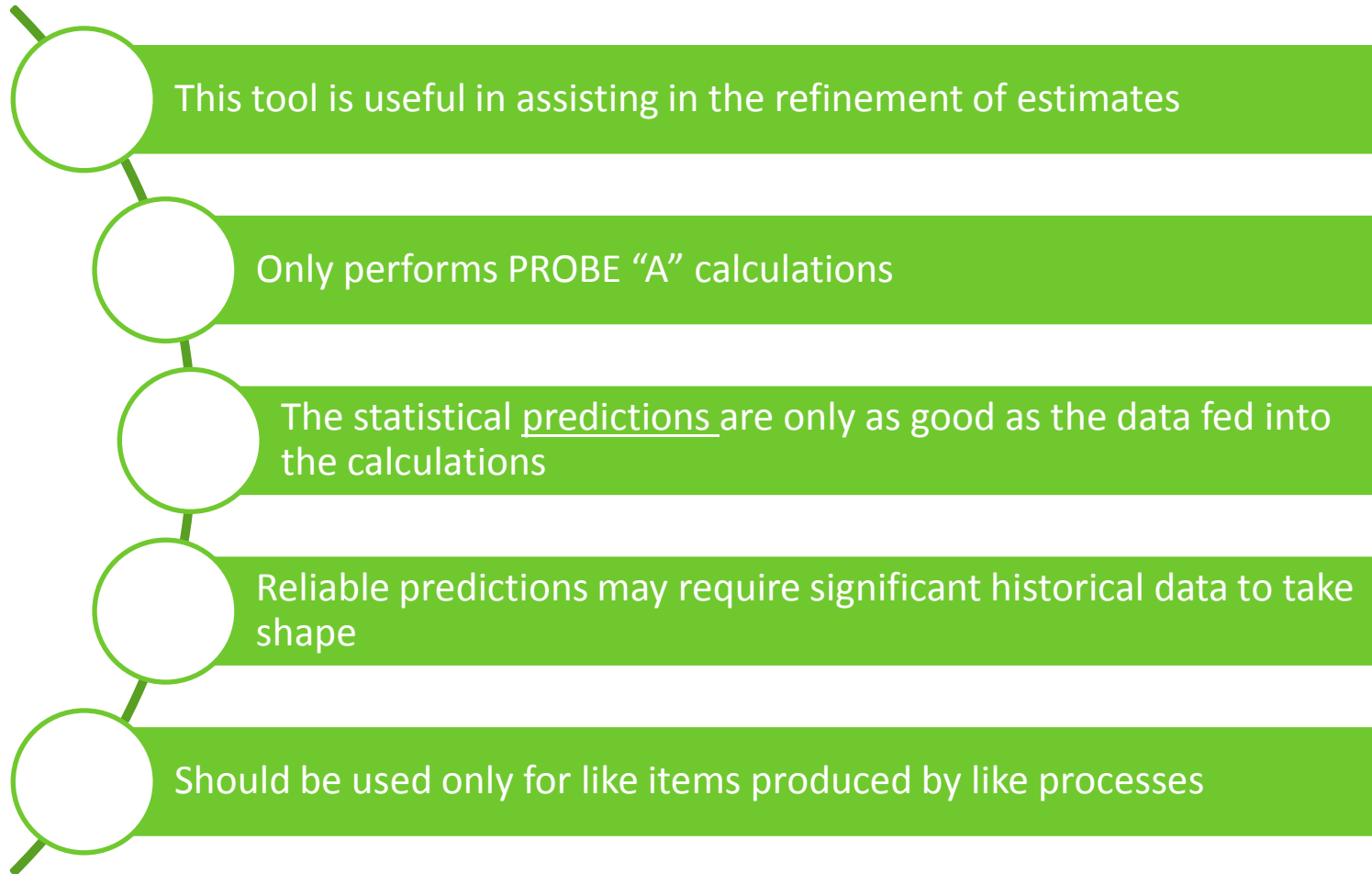
PROBE IN EXCEL – SIZE/SIZE CORRELATION CHART



PROBE IN EXCEL – SIZE/EFFORT CORRELATION CHART



PROBE IN EXCEL – CONCLUSIONS





THE ESTIMATION TOOLS: MULTI-LANGUAGE ESTIMATION

OVERVIEW

- Components that consist of parts written in different coding languages is a common situation in modern day software development
- Multiple Linear Regression works best when the majority of items in the sample have values for all categories in scope as well as the estimate to be evaluated
- The more categories, the broader and more generalized the results will be without a significantly large sample of data so treat the predictions with caution



- Tool is only as good as the data it is provided
- You need:
 - Discipline
 - Patience



MULTI-LANGUAGE ESTIMATION TOOL

- This simplified view assumes only three languages. The actual spreadsheet will allow up to five

PROGRAM	HOURS (z)	C# A&M (w)	HTML A&M (x)	JavaScript A&M (y)
A	197	1201	986	332
B	104	841	1002	0
C	173	998	3198	48
D	60	564	0	0
E	145	922	2533	185
F	64	307	552	99

Enter your Proxy Sizes Here

A&M PROXY VALUES		
C#	HTML	JavaScript
803	1243	99

Enter your P.I. Here

Prediction Interval: 68.268%

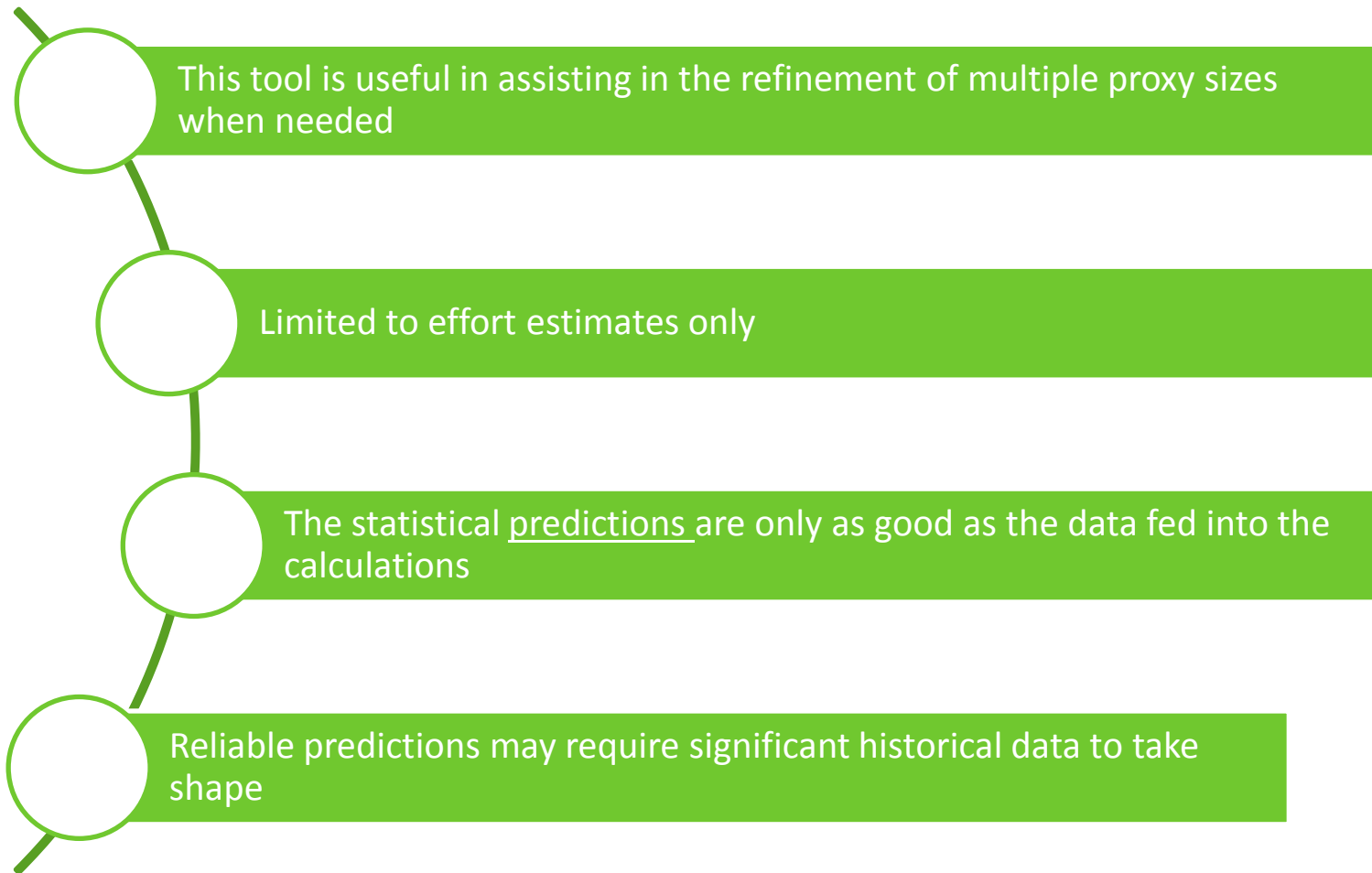
Note that the majority of the fields have actual values

The L.P.I. for the Effort Estimate is not limited to positive numbers. With small total sample sizes, or small actual A&M sizes, or significant numbers of fields set to Zero, the LPI could be a negative number (Calling for rejection of the estimate or a refinement of the P.I. Value)

EFFORT ESTIMATE		
LPI	EST	UPI
96.38	120.11	143.84
	±23.73	

Provides Effort Estimates only, not Size Estimates

MULTI-LANGUAGE ESTIMATION TOOL – CONCLUSIONS





FINAL THOUGHTS

- Usage of these tools can make for faster and better estimates
- Areas of risk can be more easily identified
- Accurate data collection requires high levels of personal and professional discipline
- The payoff will not come overnight – many data points must be collected, analyzed, and categorized
- Never lose sight that the outputs of any of these tools are predictions.
- Contact me at kkrauskopf@urbanscience.com





Questions?

