

Estimating, CAD, Build Data Roundtrip: The future of Data Analytics for Contractors

Greg Davis

Owner – AnalyticsMEP.com | DolphinConsulting.org



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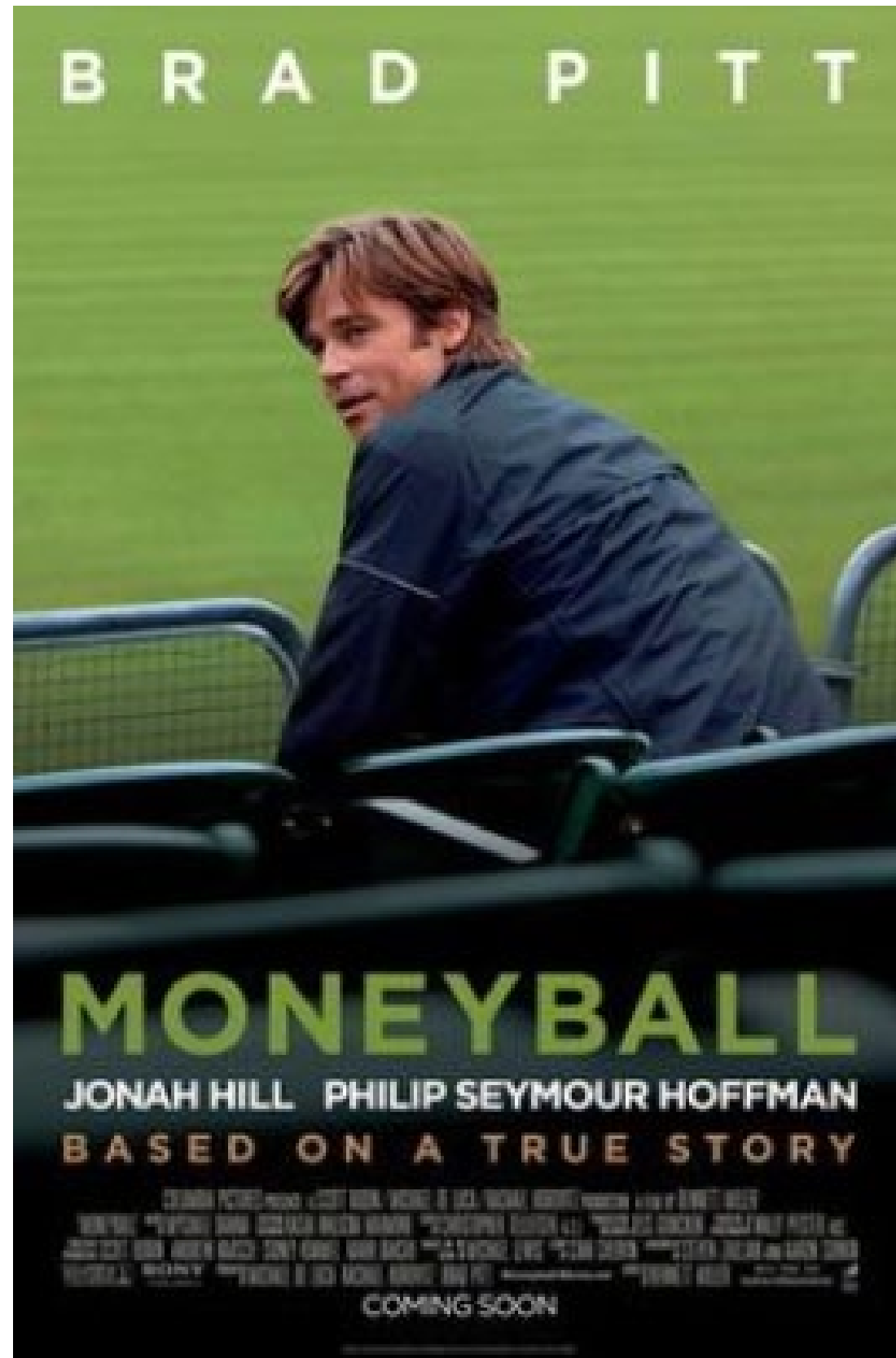
About the speaker

Greg Davis

With a background as an engineer and Project Manager for an MEP contractor, Greg is passionate about revolutionary technology in the construction industry. As co-founder of TSI (Sysque/ Building Data), Greg helped drive the industry to adopt BIM and integration.

Greg helps companies implement integrated CAD-Estimating-Manufacturing processes (using Autodesk Fabrication parts, Families and other components) and is developing the next generation software to connect the data in CAD models and Estimating systems. Because manufacturing processes are changing, new analytics based are needed and can use real installation data as a real-time feedback loop.

Analytics in the MEP Contractor world



Analytics is growing in a number of industries.

We face challenges in MEP in adoption.

- Information not shared across contractors.
- Resistance to keeping score on labor productivity
- Disconnected Systems for Estimating, CAD, and Cost Code input.

Billy Beane – Keynote Speaker

AU Construct *& Connect

(Author – Moneyball)

How to Use Data

ANALYTICS DATA IS MOST USEFUL WHEN IT IS AVAILABLE TO MAKE A DECISION

MONEYBALL AND BASEBALL

Started with Hiring Decisions (Player selection)

Had Data on Performance

Looked further into the data

EVOLUTION INTO OTHER SPORTS

Play Selection in Football

Shot Selection in the NBA

OTHER INDUSTRIES

Industries that have decision data are ahead. Consumer purchasing, logistics, Construction: Suppliers

How to use data - MEP

What Decisions do we make

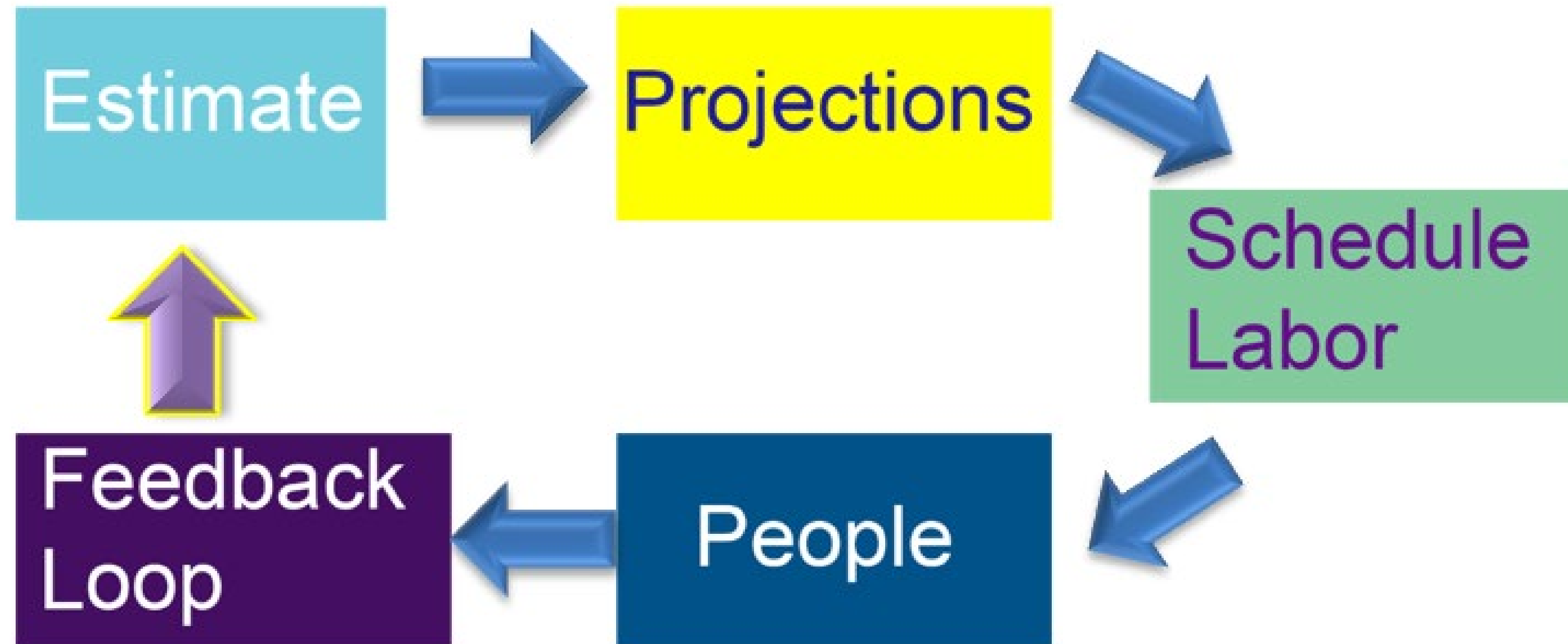
- Who to hire.
- What role to place people in.
- How much to bid for. How long (hours), how much money
- How to schedule (hours, people, timeframe)
- How much to pre-fab
- How much (how big) of a batch / Package/ Takeoff

What Challenges exist

- HR –Performance Data could be better – tied to true CAD Model
- Bidding – Feedback Loop needed from EST-CAD-Build to improve upfront bidding
- Scheduling – Feedback Loop Needed. Estimating Models accurately (and fully) a challenge

How to use data - MEP

What Can We Measure



When connected, all information can be shared and feed back to itself, improving decisions in many areas.

Industry Drivers of Change

What is Driving Change in MEP

- Challenge finding good people – people wanting to enter MEP
 - Attracting good talent
 - Grooming good people through systems
 - Building Culture and Technology that attracts people
 - Fair and Transparent Measurement and Management (fair sense of control of destiny)
- Better Financial Performance
 - Manage Cash Flow

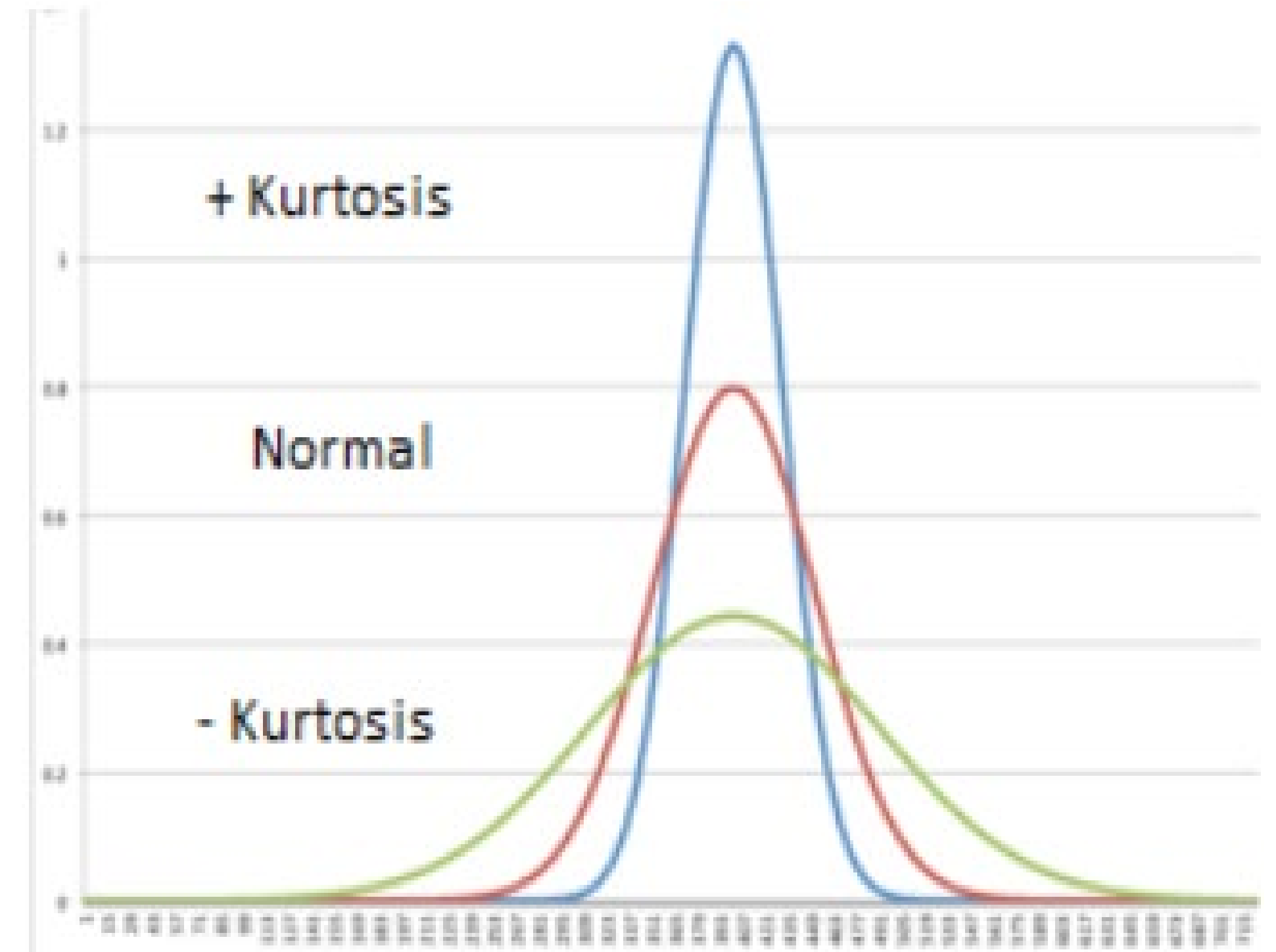
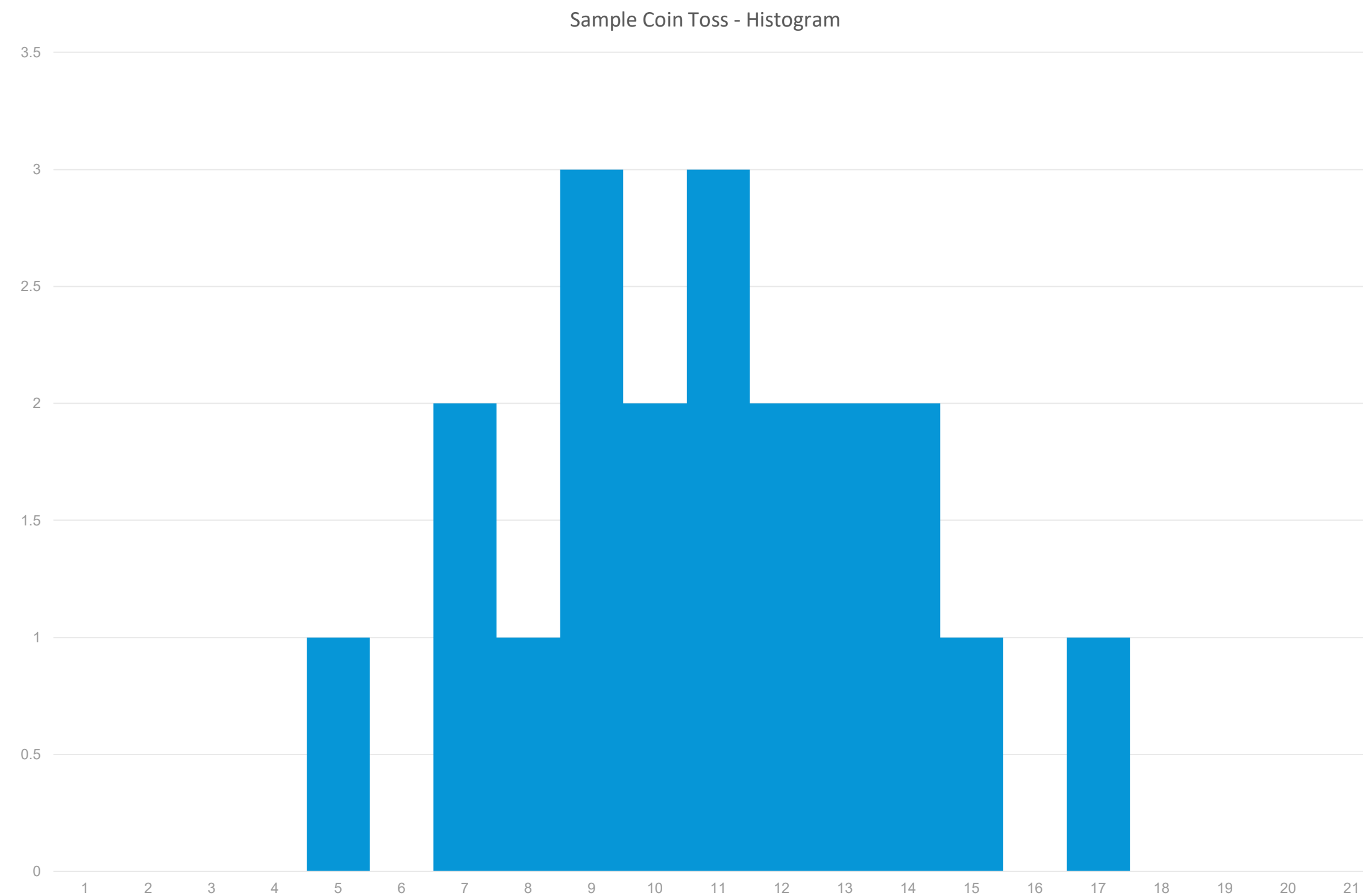
Statistics

Descriptive Statistics

- Full Population Set
- How often does something happen
- Average
- How much does it vary – how risky is it
- How can something vary but actually be predictable
- How do we make better decisions knowing that there will be ups and downs
- How do we measure if the ups and downs are reasonable

Statistics

Descriptive Statistics

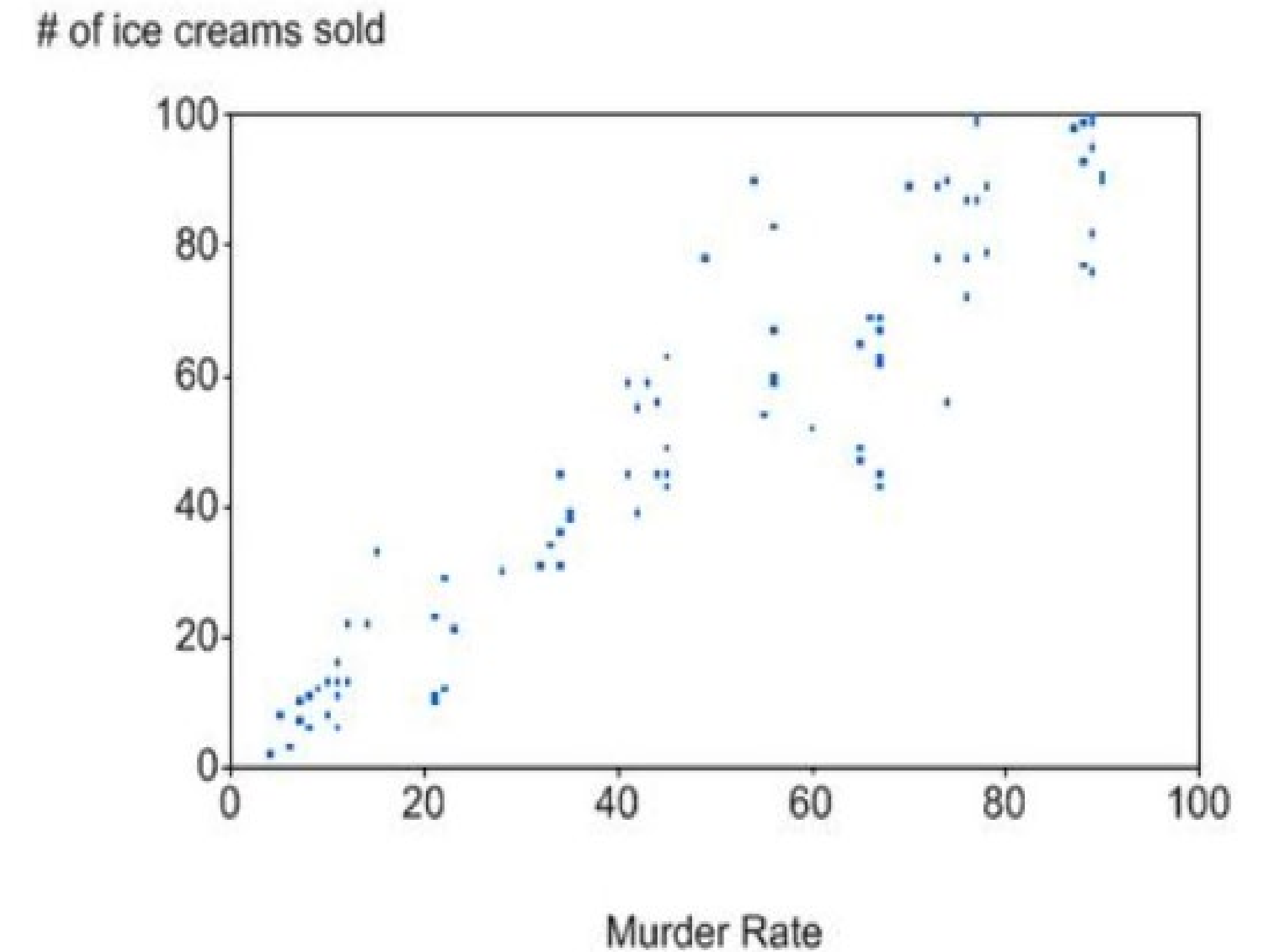


- A coin toss is a perfect 50/50 proposition. 20 tosses won't always yield 10 heads. But we expect a "Normal Distribution" of results to appear

Statistics

Inferential Statistics

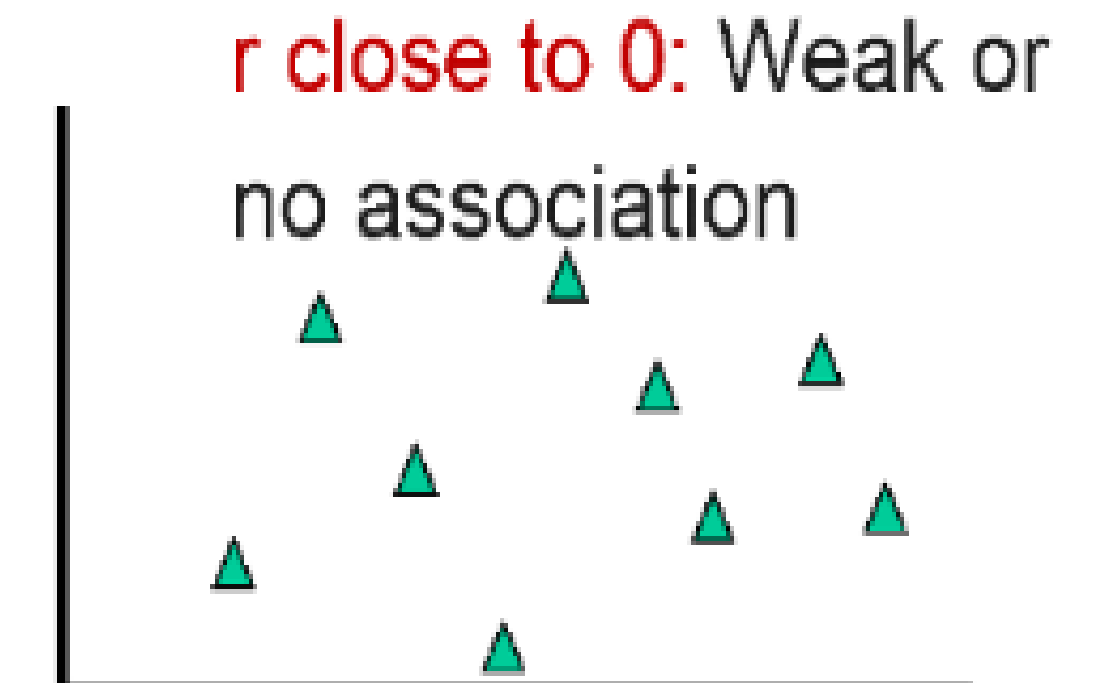
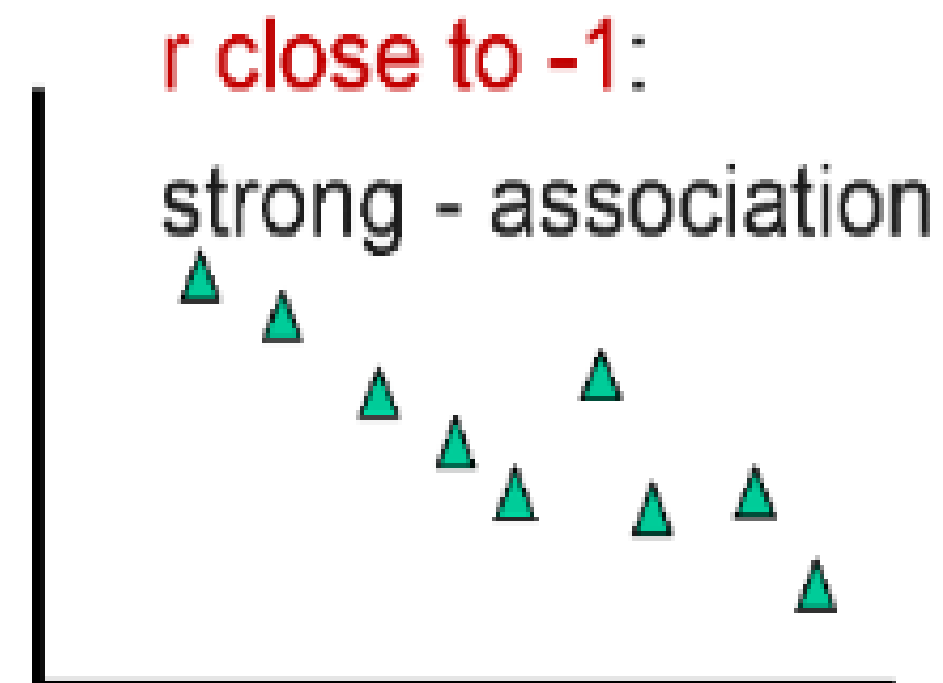
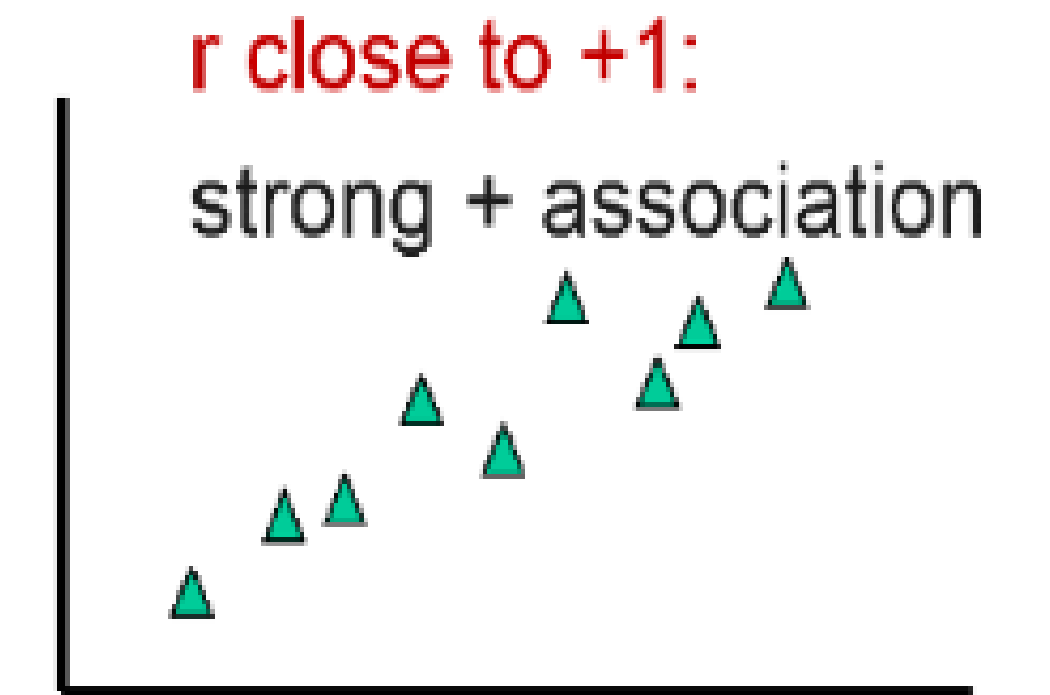
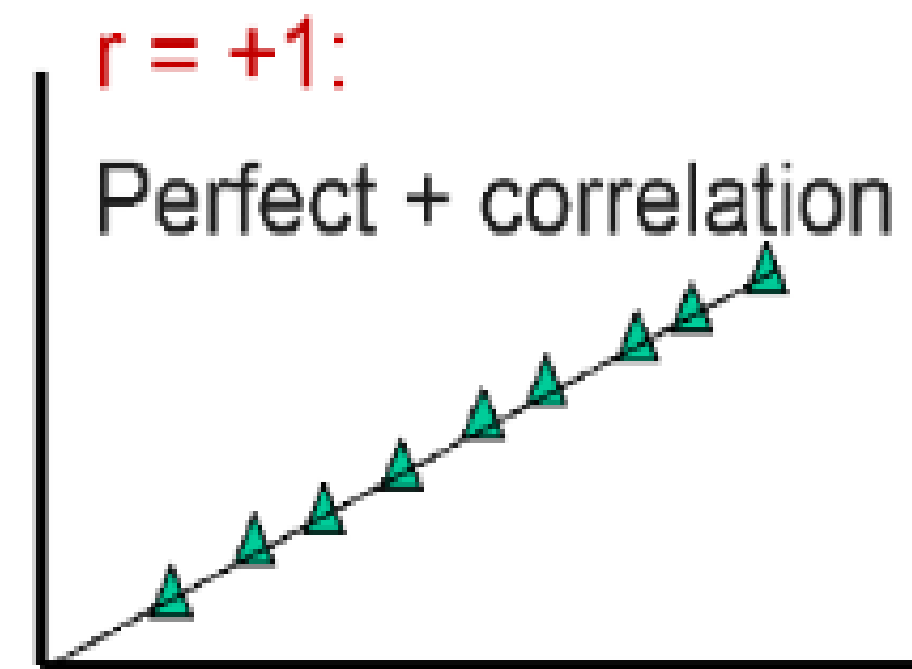
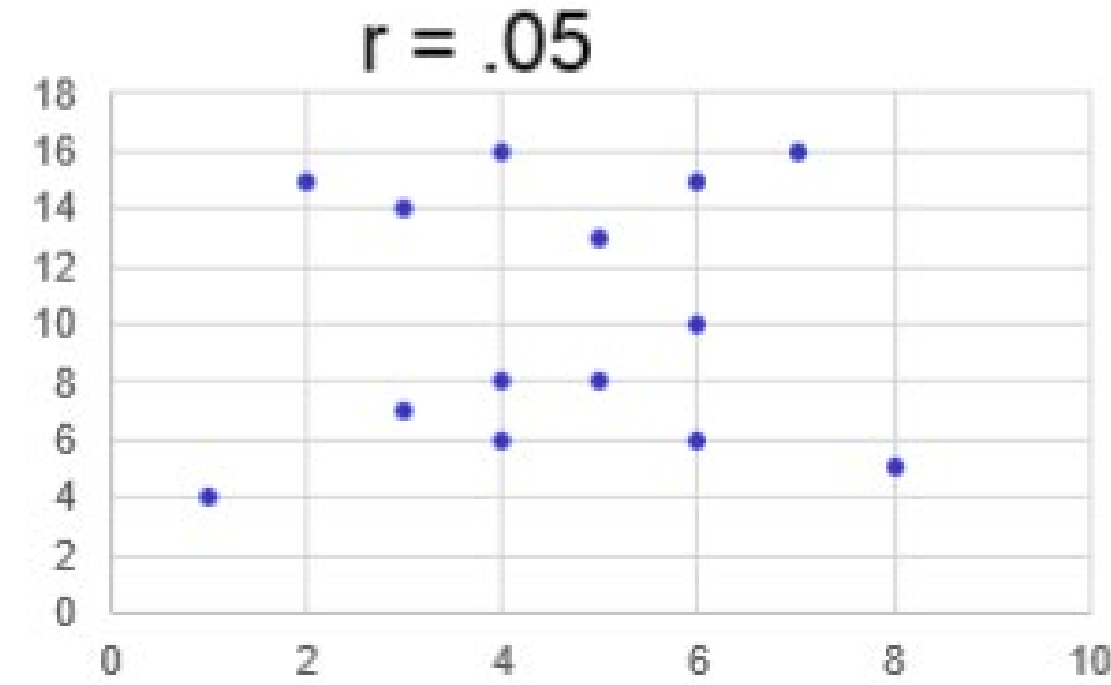
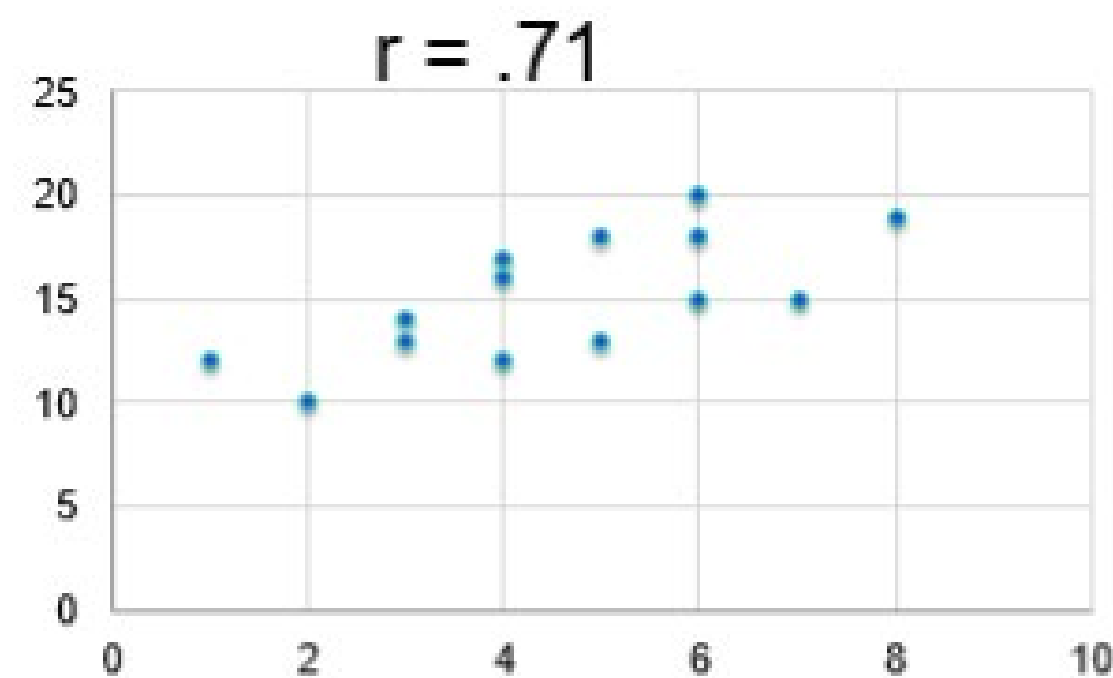
- We tend to over infer with data.
- Inferential methods can be dangerous – if you don't actually do the math
- We can use correlations effectively before we know the Cause.
- At the same time, we shouldn't conclude the cause.



Statistics

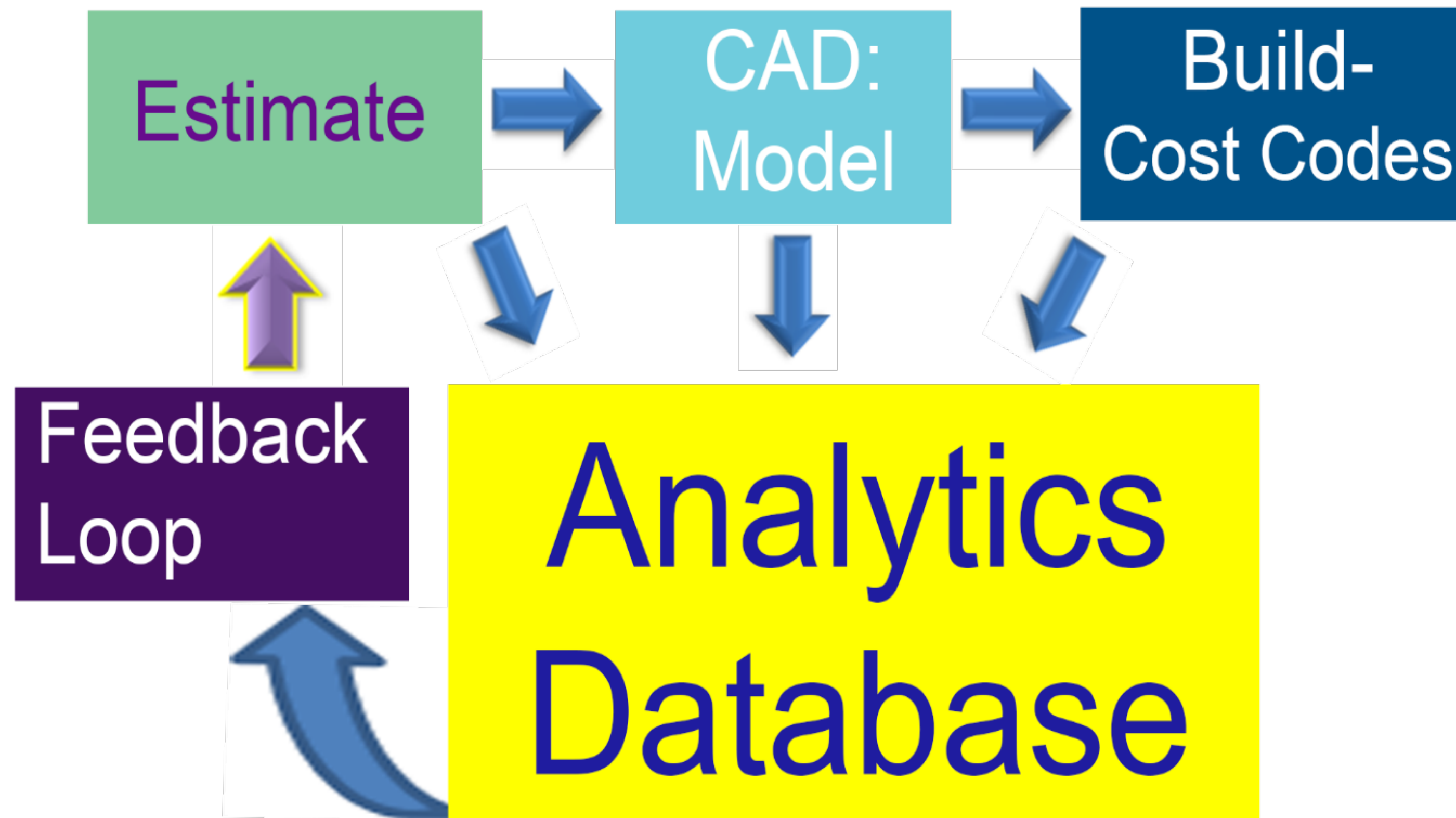
Inferential Statistics

- There is math to help us out.
- Correlation Coefficient – measure of correlation (relationship) between 2 items (factors)



EST-CAD-BUILD Loop

We have to line up data in different forms to make the loop work

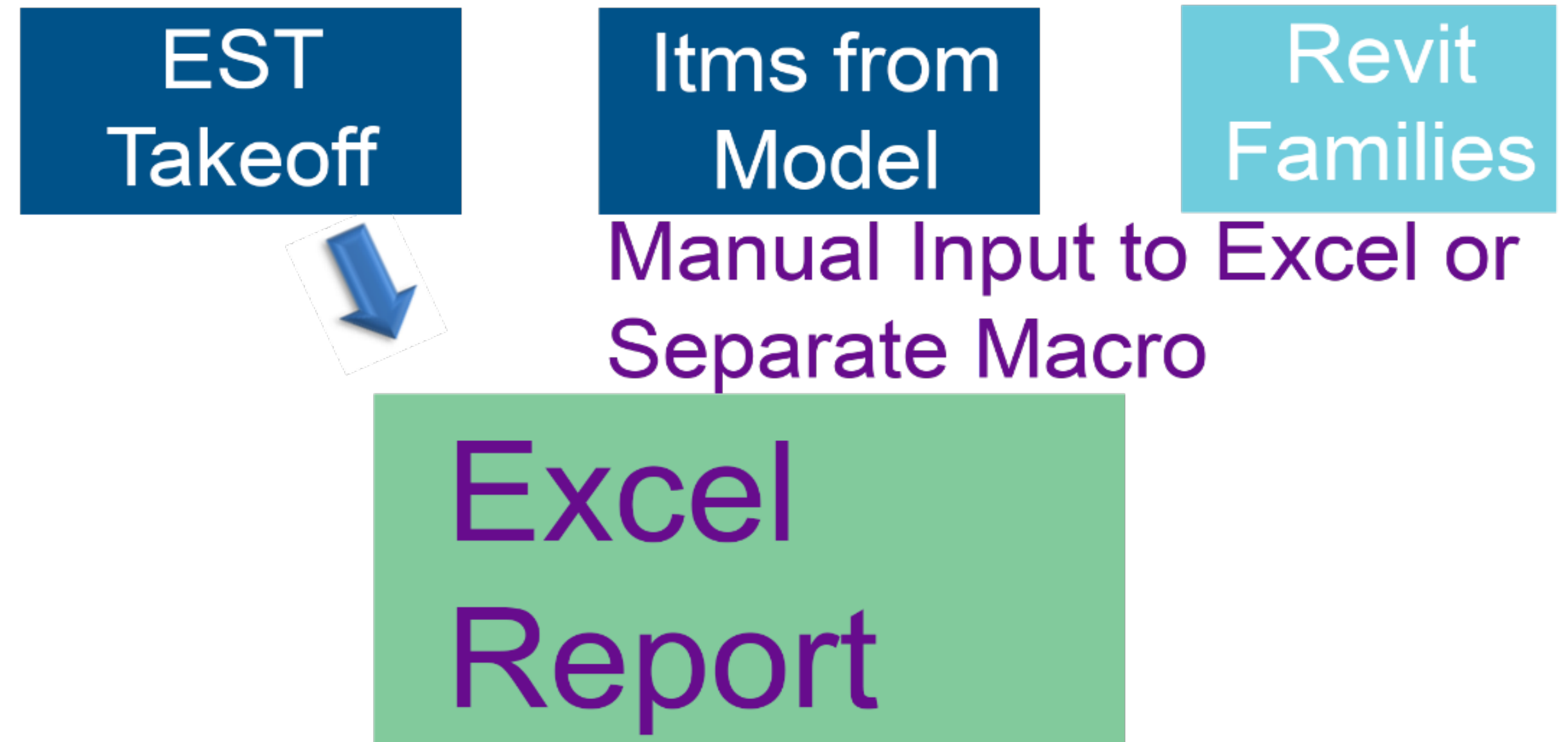


- We get different information in different forms in EST, CAD and Job Cost Accounting

EST-CAD-BUILD Loop

Sources and Data Structure Vary

- Estimating: At least Fabrication Itms and Revit Families (Revit Model Estimate)
- Estimating: Fabrication Itms (if using ESTmep)
- Estimating: 3rd Party Programs – QuickPen, Quote
- CAD: Combination of Itms and Families
- Build: Job Cost Accounting Software



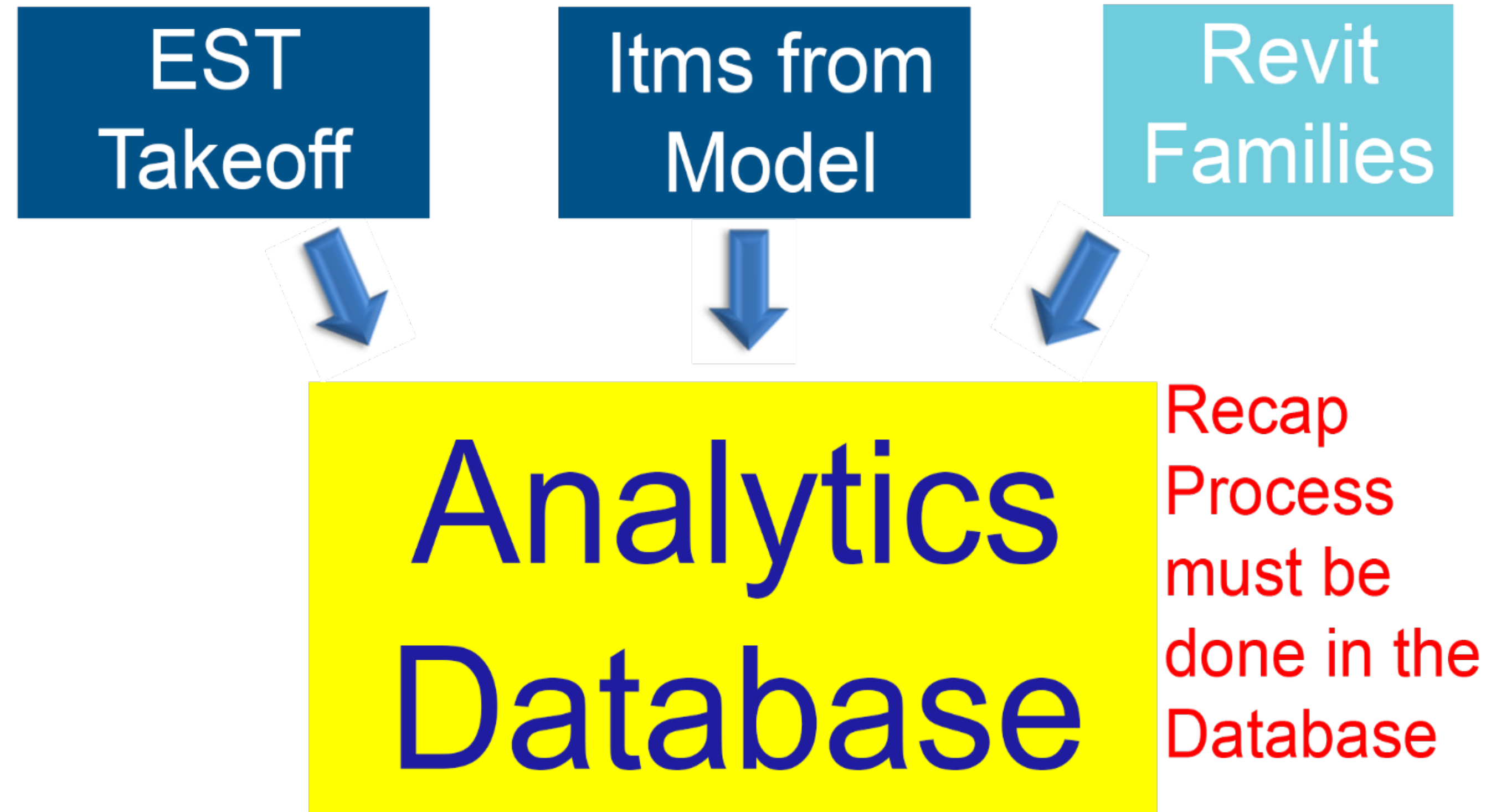
Data Disconnect

- Once Taken to Excel, the Estimate is not connected to the items any more.
- Inside of Revit, EST, CADmep, etc. Fabrication items (and Families) are not stored anywhere collectively across different takeoffs and jobs

EST-CAD-BUILD Loop

Data Driven Model

- All recaps and adjustments done with an interface to the database
- All takeoffs, Models, and Job Cost entries are brought into and stored in the database.



Data Disconnect

- Once Taken to Excel, the Estimate is not connected to the items any more.
- Inside of Revit, EST, CADmep, etc. Fabrication items (and Families) are not stored anywhere collectively across different takeoffs and jobs

Aligning Data in the EST-CAD-Build Roundtrip

Cost Codes and Automation

- Takeoff “Counting” is different than reasonable Field “Measuring” / timekeeping.
- Measurement of time needs to tie back to the taken off items.
 - Tools Like STRATUS and FabPro offer future potential automation of this alignment.
- To make the information align, your cost code structure must be predictable and consistent.
- A Cost Code Automation tool tied to the EST-CAD-Build data loop is needed to align the data

Aligning Data in the EST-CAD-Build Roundtrip

Challenges with the Fabrication Database

- Not Relational
- Data needs consistent setup
- MAPProd offers partial solution, but not a complete one.
- MAPProd and complete data setup has low adoption
- The Intent of MapProd has not been fully conveyed and is somewhat lost

Challenges with Aligning Cost Codes, Takeoffs and Estimates

- Reporting and Group is done differently in different places
- Fabrication Itm Data Structure doesn't support all Groupings that are used in practice
 - LP / MP Group, Material Groups – Copper, Steel (Install Type is / can be misaligned to cost codes)

Aligning Data in the EST-CAD-Build Roundtrip

Cost Codes Automation Sample – Can Automation be Flexible enough to accommodate different requirements for different jobs

- Goal 2000 hours max, 200 min in a cost code
- Mech PVF 8600 hours, 1800 Copper, 1800 Grooved, 5000 Welded

Material Group	Section	Hours
Copper		1,800
Ductile Iron (Grv)		1,800
CS Welded	L1M	1,200
CS Welded	L1	1,700
CS Welded	L2	1,300
CS Welded	L3	800

Aligning Data in the EST-CAD-Build Roundtrip

Cost Codes Automation Sample – Can Automation be Flexible enough to accommodate different requirements for different jobs?

- Automated Codes – with the AnalyticsMEP routine

Material Group	Section	Hours	FieldCostCode
Copper		1,800	30.1
Ductile Iron (Grv)		1,800	30.2
CS Welded	L1M	1,200	30.3
CS Welded	L1	1,700	30.4
CS Welded	L2	1,300	30.5
CS Welded	L3	800	30.6

Aligning Data in the EST-CAD-Build Roundtrip

Cost Codes Automation Sample – Can Automation be Flexible enough to accommodate different requirements for different jobs?

- Automated Codes – with the AnalyticsMEP routine Option 2

Material Group	Section	Hours	FieldCostCode
Copper		1,800	30.C
Ductile Iron (Grv)		1,800	30.D
CS Welded	L1M	1,200	30.W.L1M
CS Welded	L1	1,700	30.W.L1
CS Welded	L2	1,300	30.W.L2
CS Welded	L3	800	30.W.L3

Aligning Data in the EST-CAD-Build Roundtrip

Simple Database Example

Analytics Data and Process

Data Tables

Bids

BidID

Job Type

1001

Hospital

1002

Office

1003

Hospital

1004

Retail

Takeoffs

TakeoffID

Takeoff Type

BidID

1

EST

1001

2

EST

1001

3

CAD

1001

4

EST

1002

5

BUILD

1001

Items

Item

Weight

Field Hrs

Adj.Field Hrs

Cost Code

Line Item Code

TakeoffID

Elbow

55

1.2

1.0

20

11.1

1

Straight

65

0.4

0.4

20

11.1

2

Elbow

50

1.0

0.916

20

11.1

3

Elbow

50

1.0

.0727

20

11.1

5

Analytics Data and Process

Data Flow

Items

Item	Weight	Field Hrs	Adj.Field Hrs	Cost Code	Line Item Code	TakeoffID
Elbow	16.5	3.6	3.0	20	11.1	1
Straight	19.5	1.2	1	20	11.1	1
Straight	19.5	1.2	1.2	20	11.2	1
Straight	19.5	1.2	1.2	20	11.3	2

Totals

(20)	75.0	7.2	6.4
------	------	-----	-----

Factor CAD by EST Adj Field Hrs / Field Hrs

CAD

Elbow	15.0	3.3	2.75	20	11.1	3
Straight	19.5	1.2	1.0	20	11.1	3
Straight	19.5	1.2	1.2	20	11.2	3
Straight	19.5	1.2	1.2	20	11.3	3

Totals

(20)	73.5	6.9	6.15
------	------	-----	------

BUILD

Original EST Field Hrs (Job Cost) 7.2

Updated Forecast to Completion (Job Cost) 6.15

Actual Job Costs 4.92

Final Adj Field Hrs Build / Field Hrs EST = 4.92 / 7.2 = 0.68333

CAD-Build Field Hrs / EST Field Hrs = 6.9/7.2 = 0.958

Final Adj (Actual) Field Hrs Build / CAD-Build Field Hrs = 4.92 / 6.9

Factor to Apply to Items = .713

Analytics Data and Process

Items

Data Flow

	Item	Weight	Field Hrs	Adj.Field Hrs	Cost Code	Line Item Code	TakeoffID
EST	Elbow	16.5	3.6	3.0	20	11.1	1
	Straight	19.5	1.2	1.0	20	11.1	1
	Straight	19.5	1.2	1.2	20	11.2	1
	Straight	19.5	1.2	1.2	20	11.3	2
Totals	(20)	75.0	7.2	6.4	Factor CAD by EST Adj Field Hrs / Field Hrs		
CAD	Elbow	15.0	3.3	2.75	20	11.1	3
	Straight	19.5	1.2	1.0	20	11.1	3
	Straight	19.5	1.2	1.2	20	11.2	3
	Straight	19.5	1.2	1.2	20	11.3	3
Totals	(20)	73.5	6.9	6.15	Copy CAD Create Build (added to Takeoffs List) Factor Build by Build Actual Hrs/ Field Hrs		
BUILD	Elbow	15.0	3.3	2.353	20	11.1	4
	Straight	19.5	1.2	0.856	20	11.1	4
	Straight	19.5	1.2	0.856	20	11.2	4
	Straight	19.5	1.2	0.856	20	11.3	4
	(20)	73.5	6.9	4.92			

Analytics Data and Process

Cost Code 20 Data Summary

Item	EST Weight	Adj. Weight	EST Field Hrs (TO)	EST Field Hrs-CAD	Actual Field Hrs
Elbow	16.5	15.0	3.6	3.0	2.353
Straight	58.5	58.5	3.6	3.4	2.567
(20)	75.0	73.5	7.2	6.4	4.92

Overall

- Lbs/ Hr target (EST) = $75 / 4.92 = 15.24$
- Lbs/Hr target (CAD) = $73.5 / 4.92 = 14.93$
- Lbs Escalation Factor = $73.5 / 75.0 = 0.98$

Breakdown

- | | | |
|-------------------------|-------|----------|
| | Elbow | Straight |
| • Lbs/ Hr target (EST) | 7.01 | 22.8 |
| • Lbs/Hr target (CAD) | 6.37 | 22.8 |
| • Lbs Escalation Factor | 0.91 | 1.0 |

These breakdowns are simplified examples. They could be anything because of the flexibility of the database.

Analytics Data and Process

EST-CAD-CAM Round-Trip

Available Metrics (from this specific example)

- Job Analytics
 - Lbs/Hr target (CAD) – Improved Forecasting
- Business Analytics
 - All factors cross reference to Job Type / Industry
- Bidding Intelligence
 - Lbs/ Hr target against bid by line item (HES)
 - Lbs/ Hr target (CAD) (extra Bid option if Takeoff is very accurate)
 - Escalation Target (How much more stuff on Pounds or Labor basis do we adjust for). (2 Factor Evaluation) – improve reaction to changes in each factor (Labor rates, seasonal conditions, trade war pricing for Material)

Analytics MEP

What Types of Questions Can we Answer?

- What factor of MCAA do I bid in a Hospital, 3rd Floor Mechanical Room for a Chilled Water Main?
- What Pounds/Hour Factor should I bid for a Data Center, Medium Pressure Supply Air System with 35% fittings?
- How many Hours do I need to schedule for the 4th Floor of the Office Tower project, and how many people do I need?
- How soon do I need the prefab of duct done for the 4th floor of the Office Tower?
- How soon do I need the Copper spools done, and what day should I ship them to get the most productivity out of my labor?
- Are we over-building our Mechanical Room Skids. Can we save costs by using less framing, and doing spool connections with flanges and Victaulic couplings on site?

Analytics MEP

Online tool for Recap

- Online tools to Capture Adjustment
- Not lost like excel

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Apps

Dell Support

Autodesk Login

Autodesk Vendor P...

Creating a User Log...

Programming

Speaker Materials |...

Hi, gregdavis. Welcome to our site.

Bid (EST)

Model (CAD-Build)

Process Report

Reports - Main

Recap Report

Recap Summary

Sheet Metal Duct

Mechanical PVF

Plumbing PVF

Equipment

Fixtures

Accessories

Hangers

Subcontractors

General & Admin

Manufactured Duct

Service

None Selected

Section

None Selected

Pressure Group

None Selected

Material

None Selected

Manufactured Duct															Base Metal Cost	Adj Base Metal Cost	Full Material Cost	Adj Material Cost
Alt.	Dwg	Section	Service	Zone	Spool	Pressure Group	Material	DW	Insulation	Fitting Type	Service Type	Weight (lbs)	Pieces	Lft				
0		L1	Supply Air-2wg			LP	GALV	No		Fittings	Rectangular Duct	272,157	3,384	17,075	\$145,627.20	\$145,627.20	\$148,430.88	\$148,430.88
0		L2	Supply Air-2wg			LP	GALV	No		Fittings	Rectangular Duct	272,157	3,384	17,075	\$145,627.20	\$145,627.20	\$148,430.88	\$148,430.88
0		L2	Supply Air-2wg			LP	GALV	No		Straights	Rectangular Duct	334	18	89	\$183.78	\$183.78	\$185.40	\$185.40
0		L3	Supply Air-2wg			LP	GALV	No		Fittings	Rectangular Duct	272,157	3,384	17,075	\$145,627.20	\$145,627.20	\$148,430.88	\$148,430.88
0		L4	Supply Air-2wg			LP	GALV	No		Fittings	Rectangular Duct	272,157	3,384	17,075	\$145,627.20	\$145,627.20	\$148,430.88	\$148,430.88
0		L5	Supply Air-2wg			LP	GALV	No		Fittings	Rectangular Duct	272,157	3,384	17,075	\$145,627.20	\$145,627.20	\$148,430.88	\$148,430.88

Analytics MEP

Online Recap – Intelligent Analytics Prediction Values

- Columns to tell you what Predicted Factor should be
- Data set not adjusted at initial publish. For Update:
www.analyticsmep.com/sample.php

← → ↻ ⌂ Not secure | mep-analytics.com/Recap_Sheet_Metal/?ProjectIDpass=1

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Apps Dell Support Autodesk Login Autodesk Vendor P... Creating a User Log... Programming Speaker Materials J...

Process Report

Reports - Main

t

Fixtures

Accessories

Hangers

Subcontractors

General & Admin

lected ▼

Material

None Selected ▼

											ANALYTICS Fab								ANALYTICS Field		
Service Type	Weight (lbs)	Pieces	Lft	Base Metal Cost	Adj Base Metal Cost	Full Material Cost	Adj Material Cost	Fab Hrs	Fab Lbs/Hr	Fab FACTOR	Target Fab Lbs/Hr	Target Fab FACTOR	Adj Fab Hrs	Field Hrs	Field Lbs/Hr	Field FACTOR	Target Field Lbs/Hr	Target Field FACTOR	Adj Field Hrs		
Rectangular Duct	272,157	3,384	17,075	\$145,627.20	\$145,627.20	\$148,430.88	\$148,430.88	5,628.0	48.4	1.00	48.4	1.00	5,628.0	23,226.0	11.7	1.00	11.7	1.00	23,226.0		
Rectangular Duct	272,157	3,384	17,075	\$145,627.20	\$145,627.20	\$148,430.88	\$148,430.88	5,628.0	48.4	1.00	48.4	1.00	5,628.0	23,226.0	11.7	1.00	11.7	1.00	23,226.0		
Rectangular Duct	334	18	89	\$183.78	\$183.78	\$185.40	\$185.40	3.0	111.4	1.00	111.4	1.00	3.0	13.5	24.7	1.00	24.7	1.00	13.5		
Rectangular Duct	272,157	3,384	17,075	\$145,627.20	\$145,627.20	\$148,430.88	\$148,430.88	5,628.0	48.4	1.00	48.4	1.00	5,628.0	23,226.0	11.7	1.00	11.7	1.00	23,226.0		
Rectangular Duct	272,157	3,384	17,075	\$145,627.20	\$145,627.20	\$148,430.88	\$148,430.88	5,628.0	48.4	1.00	48.4	1.00	5,628.0	23,226.0	11.7	1.00	11.7	1.00	23,226.0		
Rectangular Duct	272,157	3,384	17,075	\$145,627.20	\$145,627.20	\$148,430.88	\$148,430.88	5,628.0	48.4	1.00	48.4	1.00	5,628.0	23,226.0	11.7	1.00	11.7	1.00	23,226.0		
Rectangular Duct	2,457	54	121	\$1,308.06	\$1,308.06	\$1,335.24	\$1,335.24	50.4	48.8	1.00	48.8	1.00	50.4	208.8	11.8	1.00	11.8	1.00	208.8		
Rectangular Duct	62,083	864	3,932	\$33,111.54	\$33,111.54	\$33,731.46	\$33,731.46	517.5	120.0	1.00	120.0	1.00	517.5	2,408.7	25.8	1.00	25.8	1.00	2,408.7		



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