



Making CMMI Level 5 Statistical Principles Palatable to an Employee-Wide Demographic



CMMI LEVEL 3 | ISO 9001:2008

- ◀ Couple of questions
- ◀ Session 1
- ◀ What worked
- ◀ Additional Resources

Lets get a current baseline of CNN viewers...



Do you watch CNN everyday?

Do you know who Anderson Cooper is?

http://video.google.com/videosearch?sourceid=navclient&rlz=1T4RNWN_enUS284US284&q=anderson%20cooper%20cnn%20heroes&hl=en&um=1&ie=UTF-8&sa=N&tab=wv#

◀ Approach for this segment

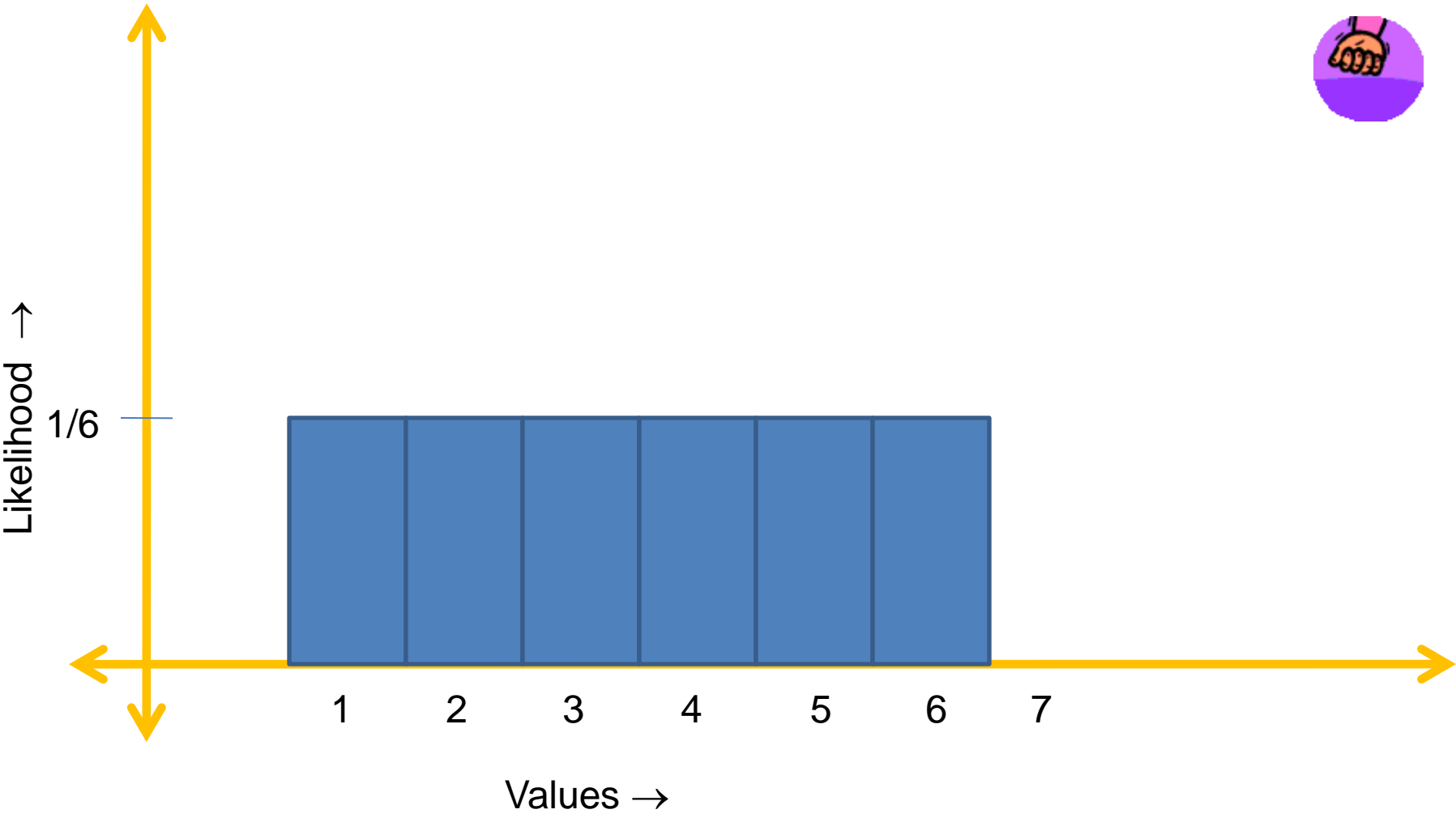
Role Play!!!

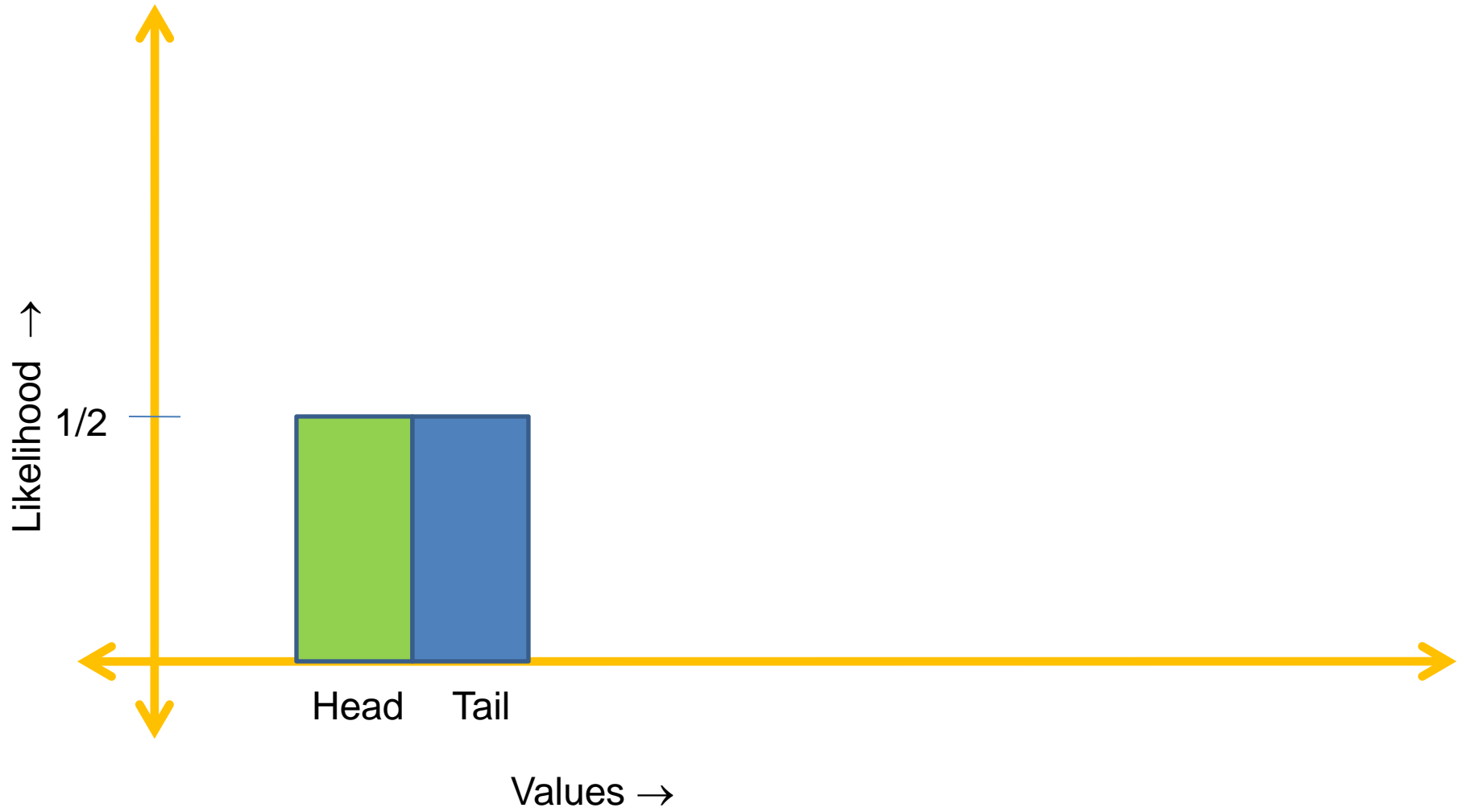
Participate!!!



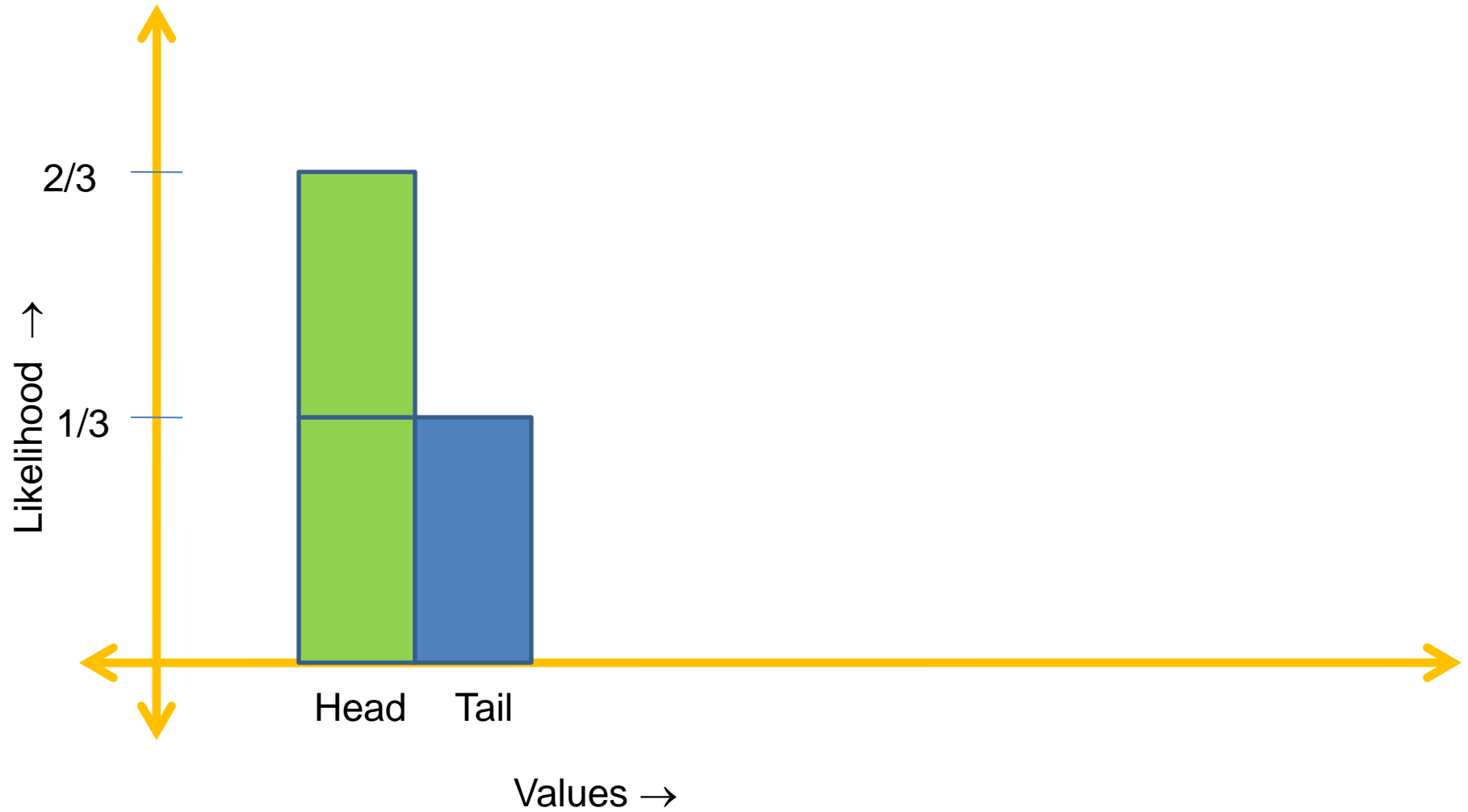
Variable "A" follows a lognormal distribution as determined by the A-D goodness of fit test. The Chi-Square test shows it has a p-value of 0.002.

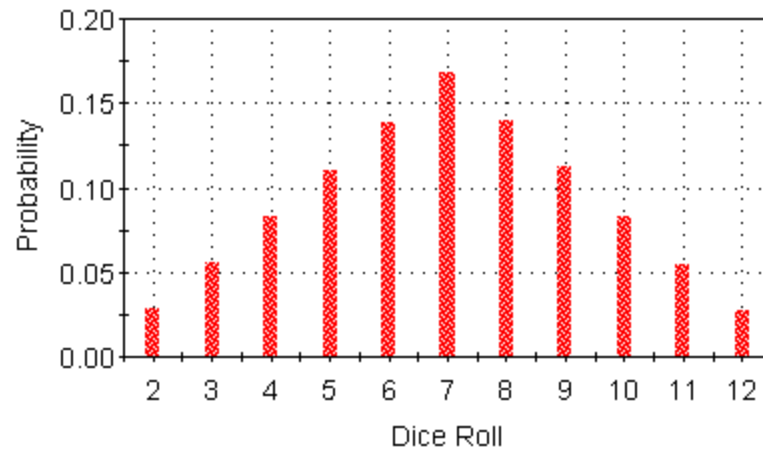
Roll a dice...





Coin toss...(unfair coin)

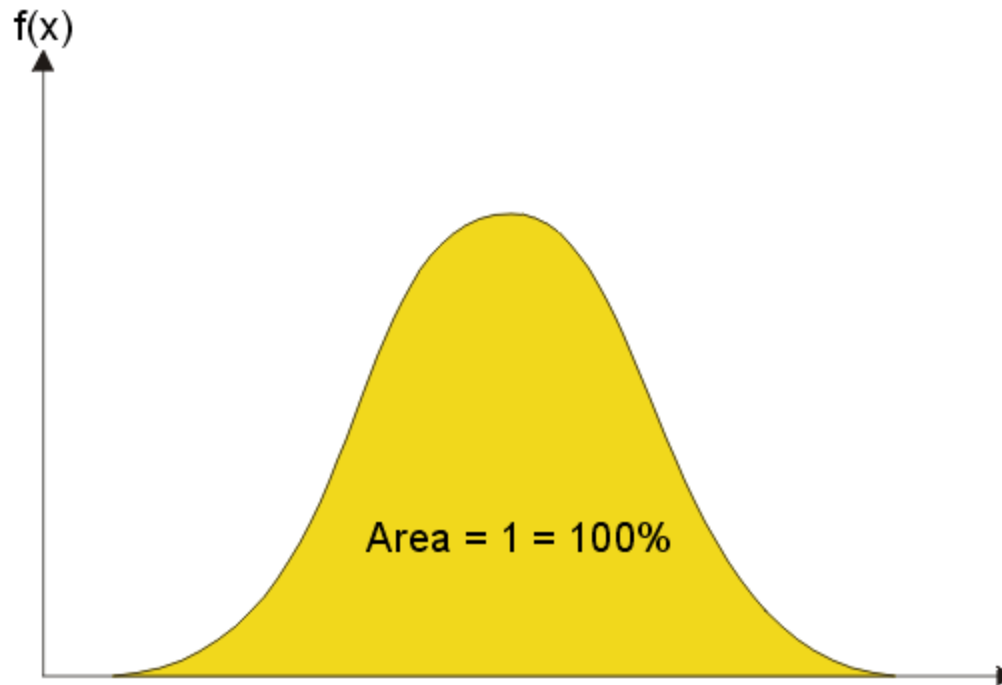




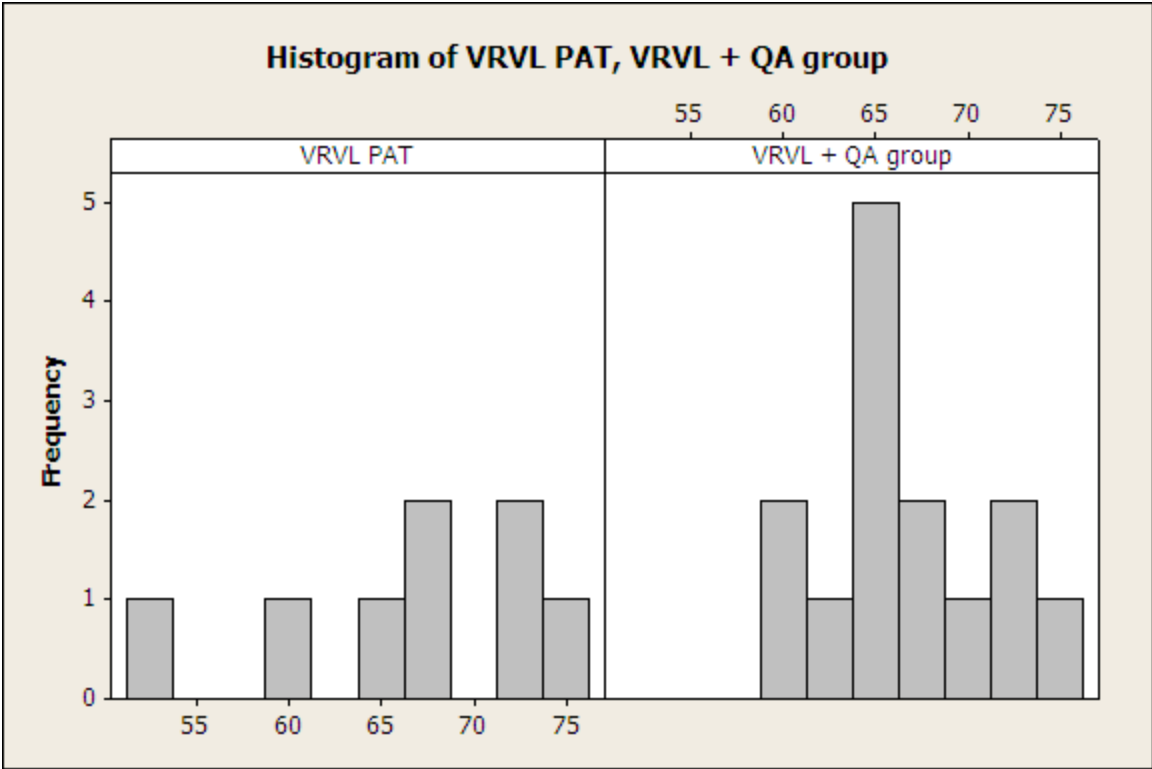
Die Roll

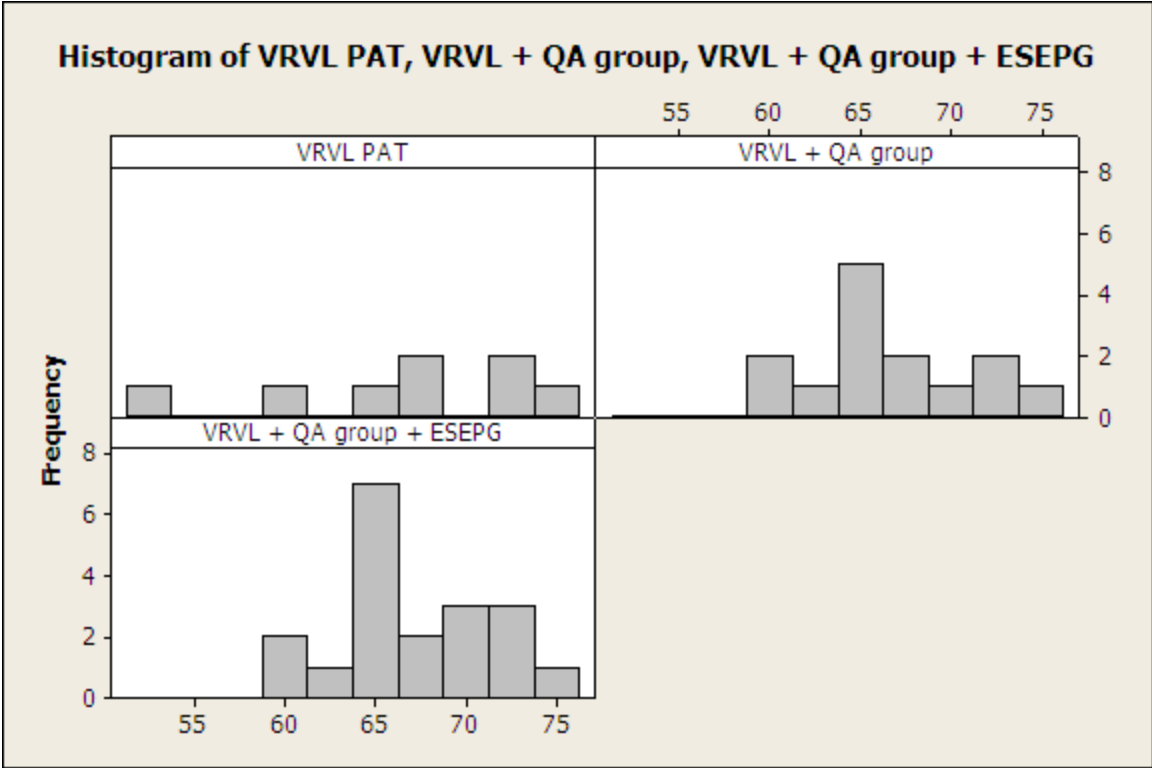


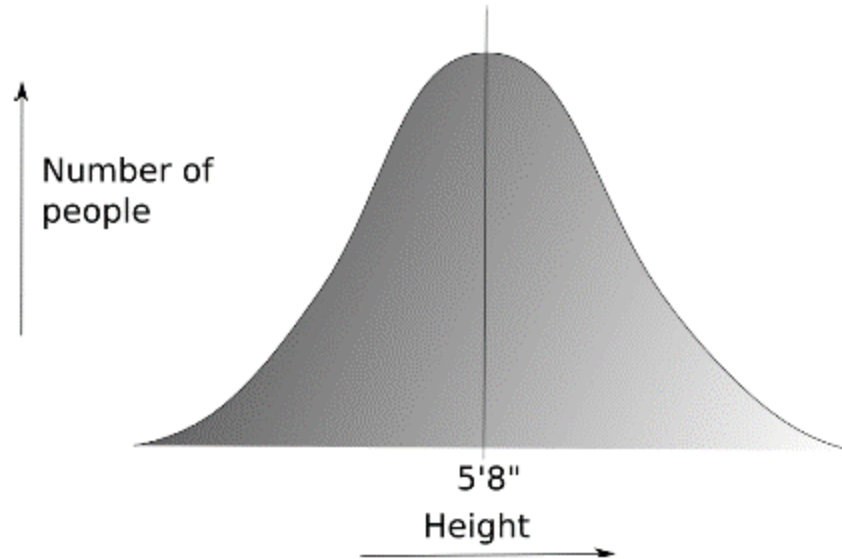
- 1
- 2
- 3
- 4
- 5
- 6



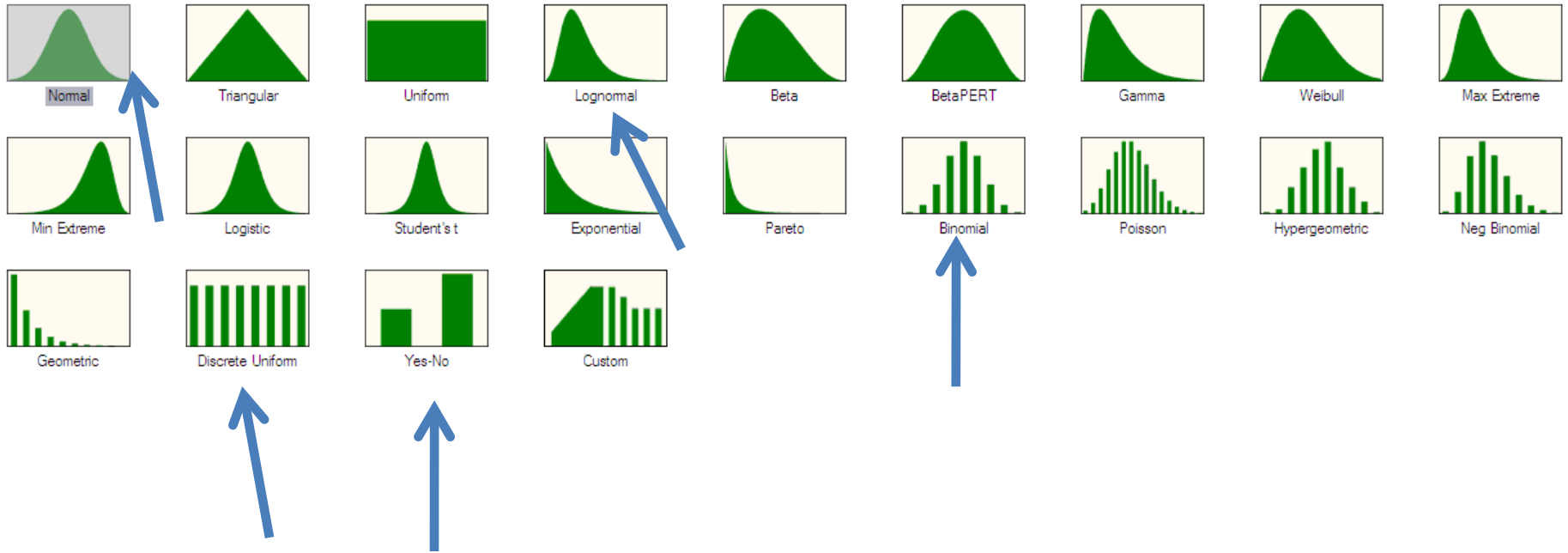
Joann – 5' 1"
Lakshmi – 5' 4"
Domenic – 5' 8"
Krithika – 5' 8"
Hongda – 6' 1"
Jerome – 6' 1"
James – 6' 3"
Charlotte - 5'6"
Carolina - 5'5"
Surya - 5'9"
Nalini - 5'0"
Barbara - 5'5"
Nishi - 5'2"
Deepti - 5'6"
Dan Renfroe -
Joe - 5'11
Jack - 5'10"
Ajay - 6'0"
Vijay - 5'5"







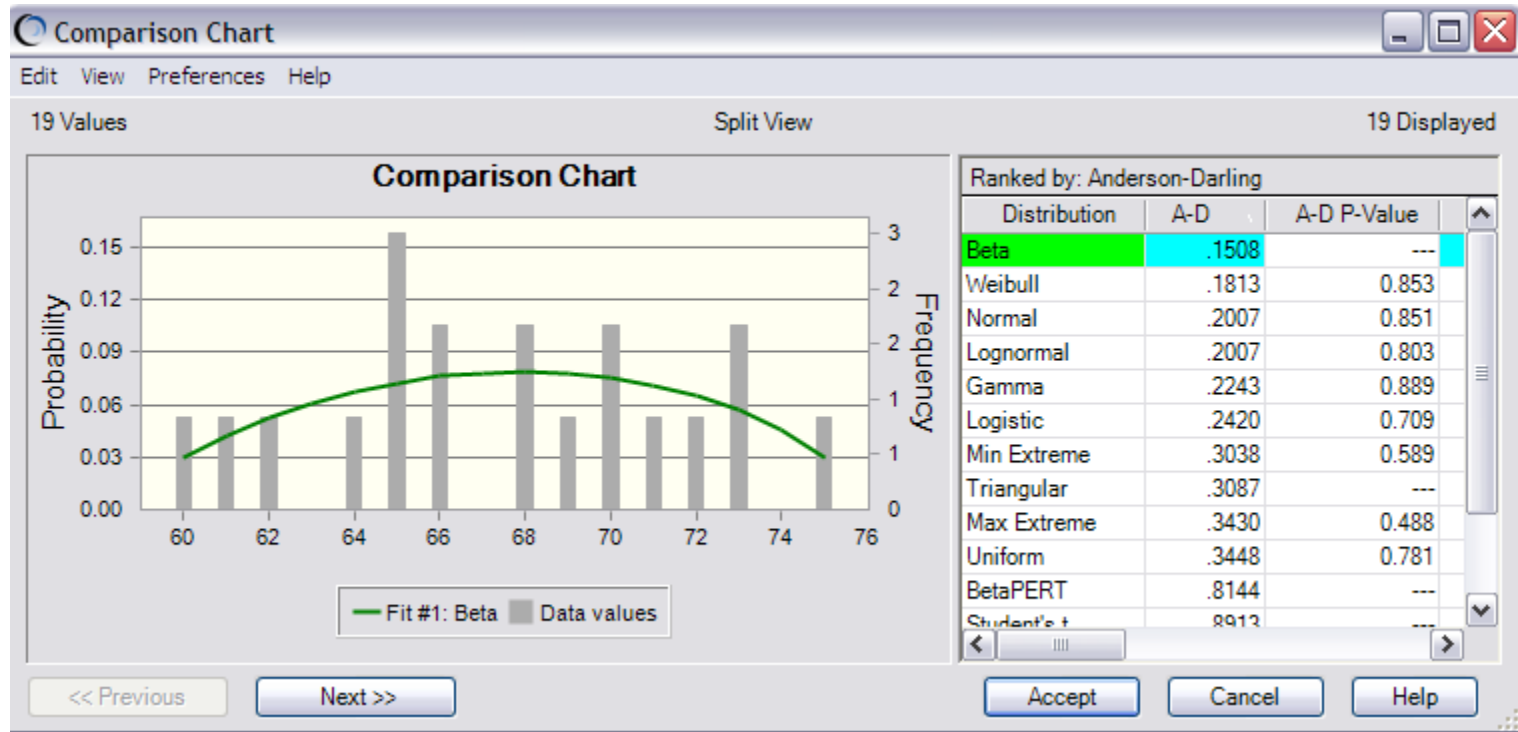
Some other distributions...



- Anderson-Darling
- Kolmogorov-Smirnov
- Chi-Square

Name	Is a good fit if...	More details
Anderson-Darling	$A-D < 1.5$	
Chi-Square	$P \text{ Value} > 0.05$	Oldest
Kolmogorov-Smirnov	$K-S < 0.03$	

Results of Goodness of fit test...for heights



A distribution... Goodness of fit... p-value

- ◀ Variable "A" follows a lognormal distribution as determined by the A-D goodness of fit test. The Chi-Square test shows it has a p-value of 0.002.

And CNN viewership??



◀ What is it now?

- ◀ CNN Viewership's?
- ◀ Do you know what Anderson Cooper looks like?
- ◀ Your “assumed identities” understanding of the statement?

Why/Why not?

- ▶ **chi-square** - The oldest and most common goodness-of-fit test. This test gauges the general accuracy by breaking down the distribution into areas of equal probability and comparing the data points within each area to the number of expected data points. Generally, a p -value greater than 0.5 indicates a close fit.
- ▶ **Kolmogorov-Smirnov** - A goodness-of-fit test, the result of which is essentially the largest vertical distance between the two cumulative distributions. Generally a value less than 0.03 indicates a good fit.
- ▶ **Anderson-Darling** - A goodness-of-fit test that closely resembles the Kolmogorov-Smirnov test, except that it weights the differences between the two distributions at their tails greater than at their mid-ranges. Use this test when you need a better fit at the extreme tails of the distributions. Generally a value less than 1.5 indicates a close fit.

◀ Thank you for the role play

This was a real session!

Moving on with our agenda....



◀ Worked well

- ▶ Socratic method
- ▶ Their data
- ▶ Everyday examples
- ▶ Everyone participates
- ▶ No fear

◀ What we are doing differently

- ▶ More exercises
- ▶ Come up with x and y factors sooner

Assignment –

Y Factor - Identify a problem/something you would like to be able to predict

- Related to work
- Having a few options is ideal as opposed to just one issue

X – Factor – For each problem identify the possible “x factors” that have an impact on the problem

- Some factors may be under your control (label them as controllable)
- Some may be outside your control (label them as uncontrollable)
- If you are not sure whether or not it makes an impact (you think it may), put it in any ways...more the merrier right now

Meeting – After completing the above two steps, set up a meeting with Deepti

- ◀ Sample models that came up
 - ▶ Time I need to spend on the help desk
 - ▶ Time to develop reports
 - ▶ Quality of end product
 - ▶ My productivity
 - ▶ LOE needed for Testing
 - ▶ Etc.

- ▶ Material from additional sessions
- ▶ If you need help, we'll be happy to chat via:
 - ▶ Email
 - ▶ Phone
 - ▶ Etc.

...to provide tips from our experience

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Any Questions?





**Appendix:
Supporting material**

- ▶ Hypothesis Tests and Jokes
- ▶ Standard Deviation and Variability
- ▶ Two real life models
- ▶ L5 and basic steps
- ▶ Tool trainings

- ▶ The NULL hypothesis was rejected in favor of the alternative hypothesis since the p value was...

- ▶ Let's get a baseline from the class
 - ▶ How many Get It?
 - ▶ Somewhat?
 - ▶ Do NOT get it?

▶ Innocent until proven guilty

▶ The person is innocent

Null Hypothesis

▶ The person is guilty

Alternative Hypothesis

Which of the above statements is...

- ▶ Status Quo
- ▶ Conventional wisdom
- ▶ Doesn't need to be proved
- ▶ Accepted without additional proof

Null Hypothesis

- ◀ Not Status Quo
- ◀ Not Conventional wisdom
- ◀ The burden of proof rests on
 - One who challenges
 - Makes a new claim
 - Wants to change the status quo

So what's a hypothesis test?

- ✓ ...To Suppose
- ✓ A pair of statements (not questions)
- ✓ Can be tested
- ✓ Has a clear yes/no answer
- ✓ If one is true the other is false
- ✓ Nothing "slips through the cracks"

Ho: Djindo is on the AITS project.
Ha: Djindo is not on the AITS project.

Ho: Sonu is on the AITS project.
Ha: Jadrana is not on the HSEEP project.

Ho: Dan's height is 5.11.
Ha: Dan's height is 6.2.

Ho: Is Arthur really tall?
Ha:

Ho: Is Surya a Doctor?
Ha:

So what's a hypothesis test?

- ✓ ...To Suppose
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- ✓ Nothing "slips through the cracks"

Ho: Kusum was born in Washington DC.
Ha: Kusum was not born in Washington DC.

Ho: Julie is a doctor.
Ha: Julie is not a doctor.

Ho: Sean watches CNN every day.
Ha: Sean does not watch CNN every day.

So what's a hypothesis test?

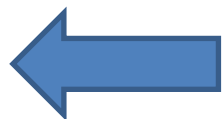
- ✓ ...To Suppose
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Ho: Apple's help desk answers calls in 2 min or less.
Ha: Apple's help desk answers calls in more than 2 min.

Ho: The average GPA of GW is 2.6 or higher.
Ha: The average GPA of GW is less than 2.6.

Ho: Dan's height is 5.11 or taller.
Ha: Dan's height is less than 5.11.

◀ P-Value...



When the p is low, the null must go



When the P is high, the null must fly

Less than ($<$) 0.05 or 5%

Equal to or Greater than (\leq) 0.05 or 5%

So what's a hypothesis test?

$p = 0.25$

Ho: Apple's help desk answers calls in 2 min or less.

Ha: Apple's help desk answers calls in more than 2 min.

Ho: The average GPA of GW is 2.6 or higher.

Ha: The average GPA of GW is less than 2.6.

$p = 0.04$

Ho: Dan's height is 5.11 or taller.

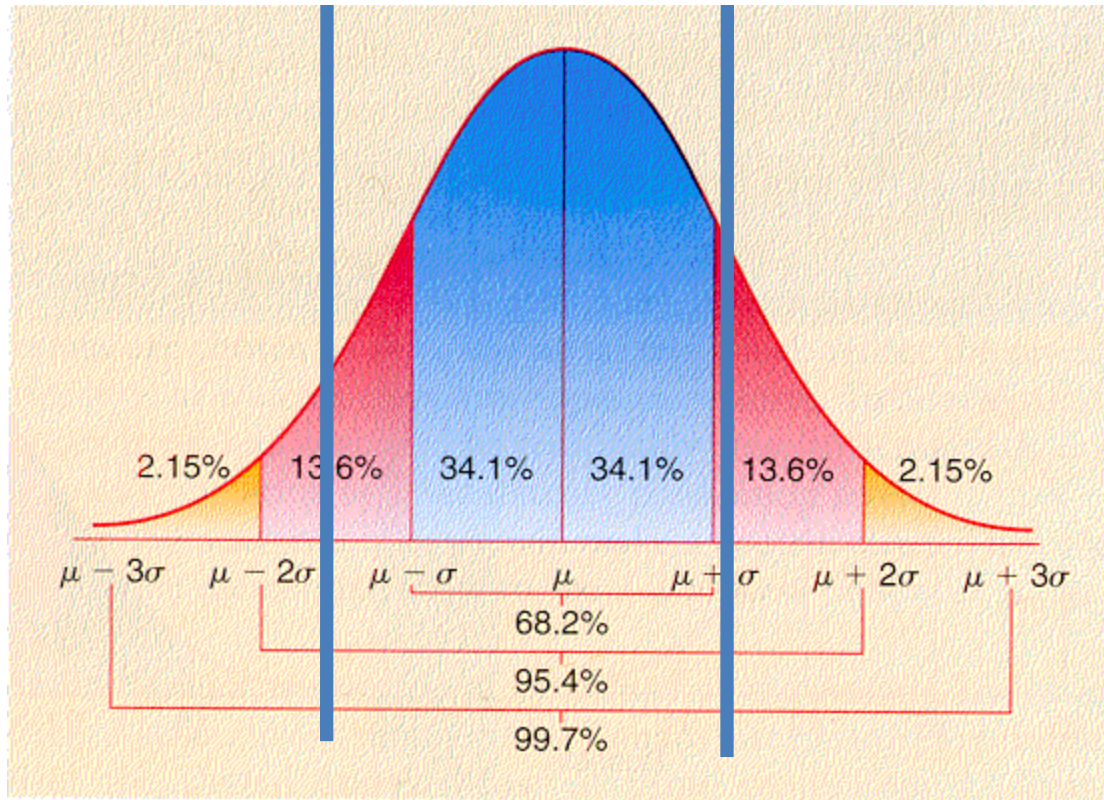
Ha: Dan's height is less than 5.11.

$p = 0.80$

- ▶ The NULL hypothesis was rejected in favor of the alternative hypothesis since the p value was...

- ▶ Let's get a baseline from the class
 - ▶ How many Get It?
 - ▶ Somewhat?
 - ▶ Do NOT get it?

◀ Probability of Null being true...or accepting the null



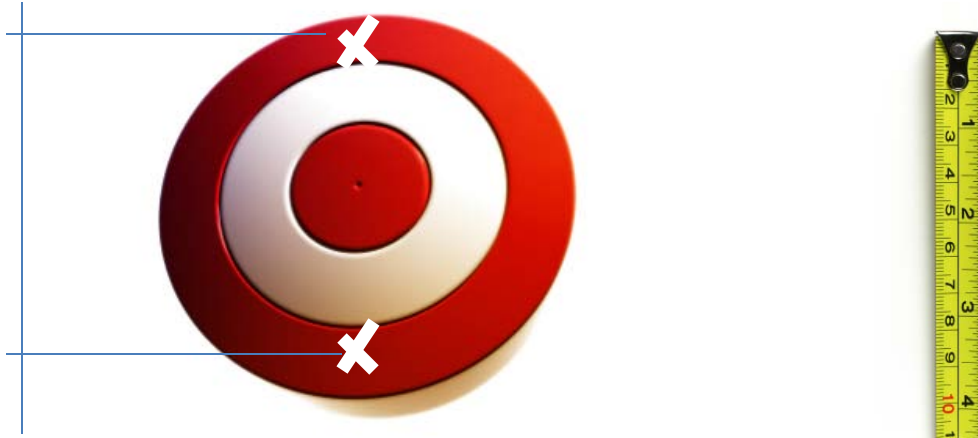
Any Questions?



◀ CENTRAL TENDENCY

- ▶ Mean/Average
- ▶ Median

◀ VARIANCE



May be a far cry from reality...

The weakness of using Central tendency alone...



You are a Manager for Boeing.

Expectation - 50 jet engines on June 29th.

You will store them in a warehouse.

Each day (late) – You loose \$2 million.

Each day (early) – You pay \$50,000 extra for warehouse costs.

Bidder A: Average 20 days

Bidder B: Average 20 days



◀ Bidder A

- ▶ 10 days
- ▶ 20 days
- ▶ 30 days

• Bidder A
-10,0,10

◀ Bidder B

- ▶ 19 days
- ▶ 20 days
- ▶ 21 days

• Bidder B
-1,0,1

Not a good measure of reliability...

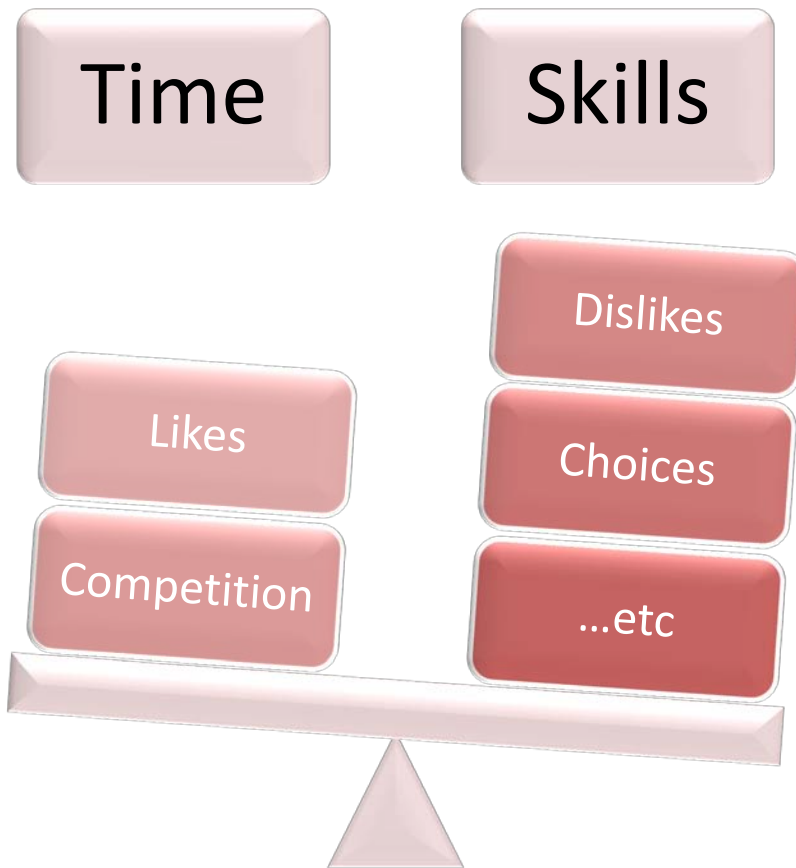
- ▶ -10, 0, 10
- ▶ Square them first – 100, 0, 100
- ▶ Divide by total number of values
- ▶ Square root
- ▶ Standard Deviation –

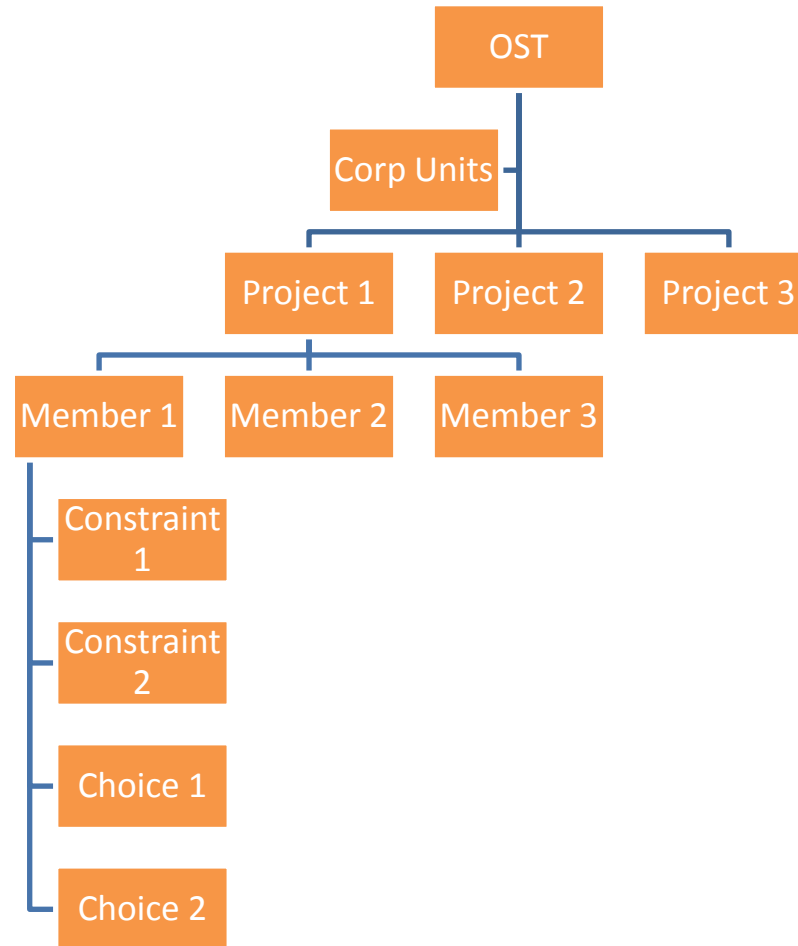
$$\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^N (X_i - \mu)^2}$$

 baselines

- ▶ Keeping planes in the air
- ▶ Ensuring people have access to insurance claims
- ▶ Ensuring government's money is spent well
- ▶ Housing for the needy
- ▶ Homeland Security
- ▶ Tracking progress for government spending

- ◀ Continuously...
- ◀ In spite of the constraints...





So now that we have variability...what can we do?



LO

Blind
Guessing



Educated
Guessing



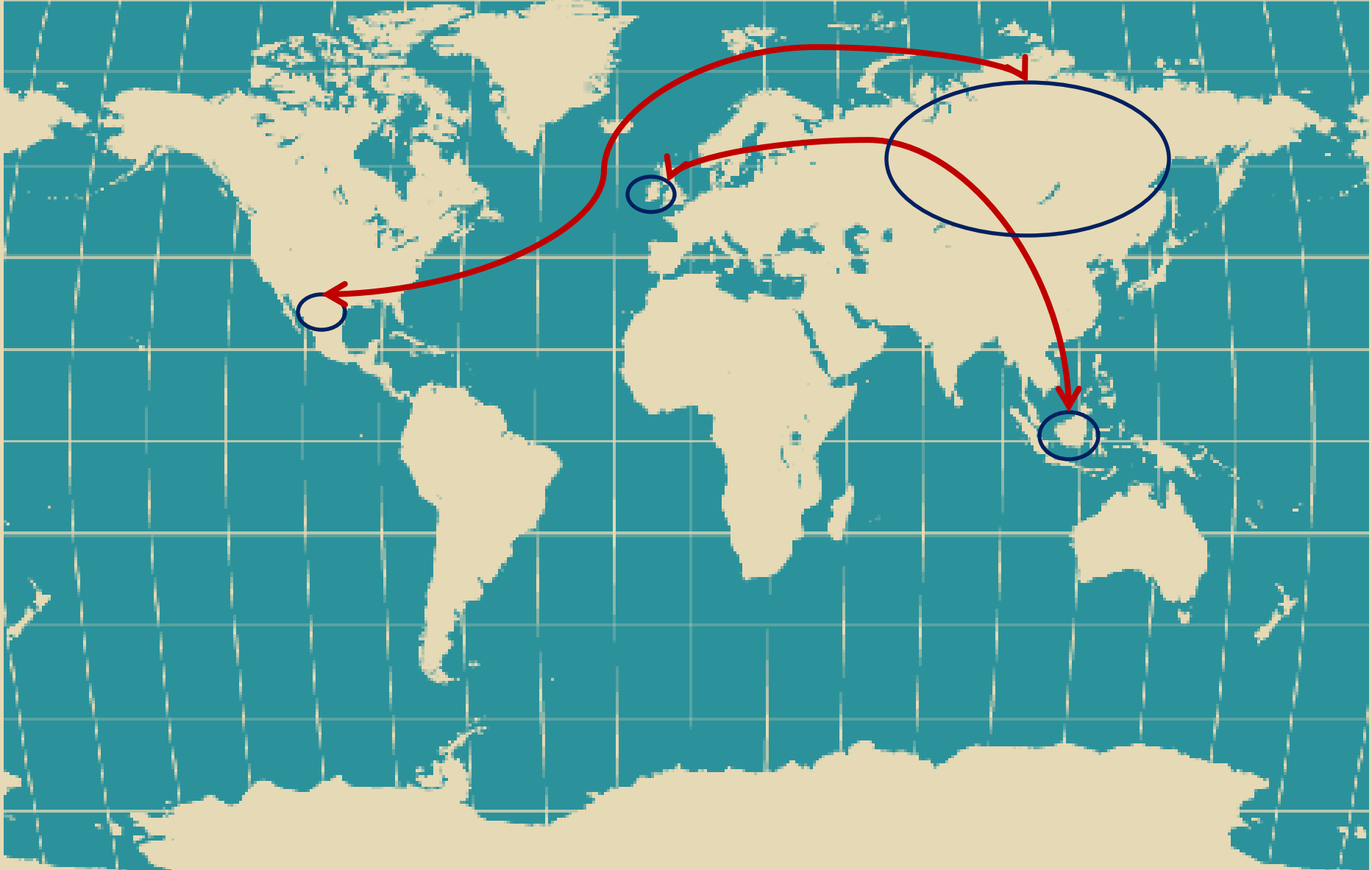
Systematic
Prediction

Make the variability go away..

Nirvana

◀ The Heart Break Model

- ▶ Heart Break...
- ▶ Stress cardiomyopathy
- ▶ Apical ballooning syndrome
- ▶ Mr. Li goes to Wallstreet
- ▶ Default Correlation
- ▶ Examples –
 - Chance of a dairy farm going bust – 10%
 - Chance of a dairy going bust – 5%
 - What if the dairy farm goes bust
 - And what if the dairy gets its supplies from this dairy...
 - Chance of dairy going bust...Rise



- ▶ Now that I have a model...
- ▶ Don't need conventional wisdom...
- ▶ Rating Agencies...
- ▶ Lot's of buyers...
- ▶ Market explosion...
 - ▶ From 10's of billions of \$ in 2000 to \$2 trillion in 2007
- ▶ Supply and demand...
- ▶ Loans become cheap...qualify easily
- ▶ Defaults...

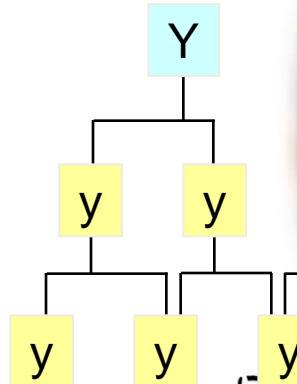
- ▶ Banks are scared to lend
- ▶ Liquidity dries up
- ▶ Businesses can't get loans
- ▶ Economy grinds to a halt...

- ◀ Companies and people are different
- ◀ Models weren't updated
- ◀ Assumptions...
- ◀ Not used as intended...
- ◀ Understanding...

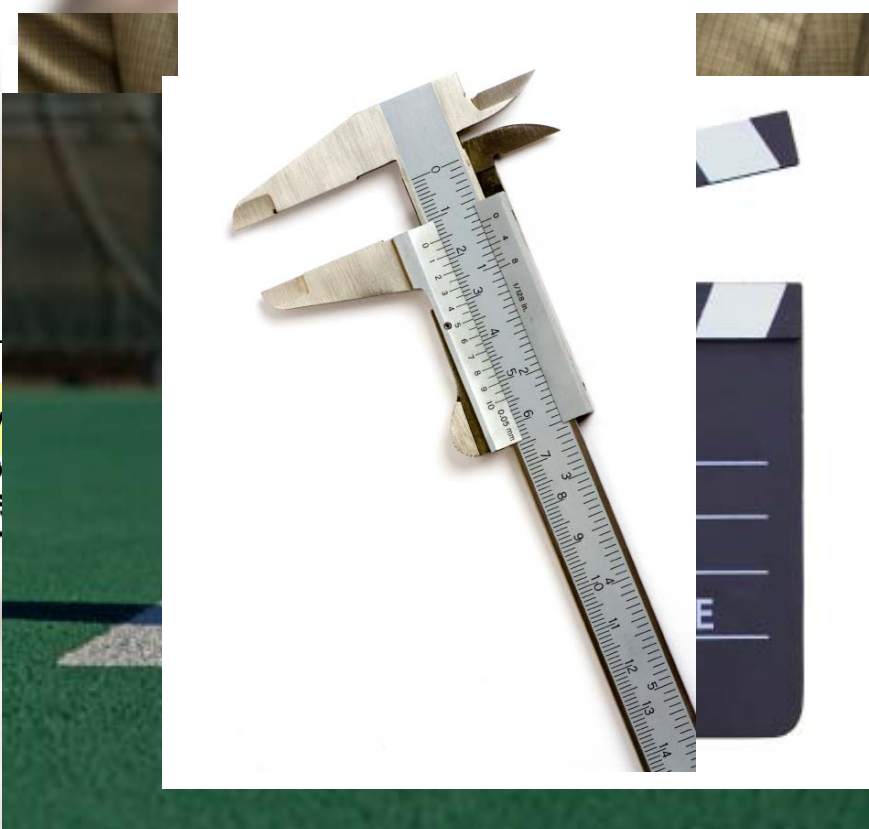
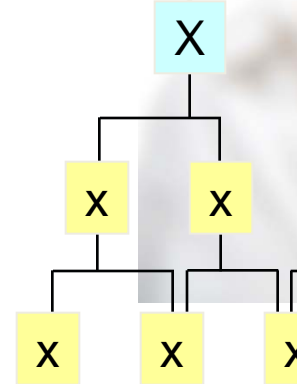
◀ OST Accounts

- ▶ Know before you go – Risk Free!
 - What if scenarios – Virtually
 - Efficiencies
 - Bottlenecks
- ▶ Great Idea? Synergy!
- ▶ Accurately Evaluate Opportunities
- ▶ Powerful clear communications
- ▶ Predict the future!!

Process-Agnostic



Process-Oriented



Business Goals
(Scorecard)

Business Goals
(Buckets, Performance)

Level Process
(Operational Processes)

Processes
(Vital x

sub-process to be tackled
by DMAIC team)

Access Data Quantity and
Credibility
Identify Areas Based on
Identify Outcomes (Y) and
processes/Model
factors (X)

MUST READ

Three men are in a hot-air balloon. Soon, they find themselves lost in a canyon somewhere. One of the three men says, "I've got an idea. We can call for help in this canyon and the echo will carry our voices far." So he leans over the basket and yells out, "Hellllooooo! Where are we?" (They hear the echo several times.)

Fifteen minutes pass. Then they hear this echoing voice: " Hellllooooo! You're lost!!" One of the men says, "That must have been a statistician." Puzzled, one of the other men asks, "Why do you say that?" The reply: "For three reasons. (1) he took a long time to answer, (2) he was absolutely correct, and (3) his answer was absolutely useless."

I asked a statistician for her phone number... and she gave me an estimate.

ARGUING WITH A STATISTICIAN IS A LOT LIKE WRESTLING WITH A PIG. AFTER A FEW HOURS YOU BEGIN TO REALIZE THE PIG LIKES IT.

Then there's the one that if you laid every statistician on the face of the earth end to end you wouldn't reach a conclusion.....Probably.

There was this statistics student who, when driving his car, would always accelerate hard before coming to any junction, whizz straight over it , then slow down again once he'd got over it. One day, he took a passenger, who was understandably unnerved by his driving style, and asked him why he went so fast over junctions. The statistics student replied, "Well, statistically speaking, you are far more likely to have an accident at a junction, so I just make sure that I spend less time there."

JUST FOR FUN

Three professors (a physicist, a chemist, and a statistician) are called in to see their dean. Just as they arrive the dean is called out of his office, leaving the three professors there. The professors see with alarm that there is a fire in the wastebasket.

The physicist says, "I know what to do! We must cool down the materials until their temperature is lower than the ignition temperature and then the fire will go out."

The chemist says, "No! No! I know what to do! We must cut off the supply of oxygen so that the fire will go out due to lack of one of the reactants."

While the physicist and chemist debate what course to take, they both are alarmed to see the statistician running around the room starting other fires. They both scream, "What are you doing?"

To which the statistician replies, "Trying to get an adequate sample size."

The Fake Software project



Hi Team –

Your our VRVL PAT meeting tomorrow, we will **pretend** to be working on a software project’s proposal. We are working on cost proposal which needs estimation. We need to develop an application for a college that allows –

- A alum to log in
- Search a database of alum’s by last name, first name, year of graduation
- Record up to 10 personal contacts

This is the only information we have and we need to respond to the proposal, the window for asking questions is over...ha, ha, ha! So just do your best with the information at hand.

Here are the responsibilities

Phase	Owner/You are assigned...
Requirements	Dom
Design	Hongda
Development	Lakshmi
Integration	James
Test	Rhiya, Joann
UAT	Jerome, Sujani

Please provide estimates for each of the phases **you are assigned** to in the following format –

Category	Estimate of hours
• Most likely number of hours needed to complete the task	•
• Minimum hours/Best Case	•
• Maximum hours/Worst case	•

If this whole exercise, including the optional step is taking you more than 10 minutes, please stop!! We will just do it in the meeting then. Else, please try to send it to me any time before the PAT meeting.

One last thing, you may want to do a “bottom up estimate”. **(Optional Step)**

- That is jot down sub-tasks E.g. for requirements – meeting with customer, developing first draft, conducting peer review, fixing issues, sign off meeting etc.
- Assign hours to each task
- Provide the total in the table above, but bring the details to the meeting.