



29th Annual **INCOSE**
international symposium

Orlando, FL, USA
July 20 - 25, 2019

The Good, The Bad & The Ugly

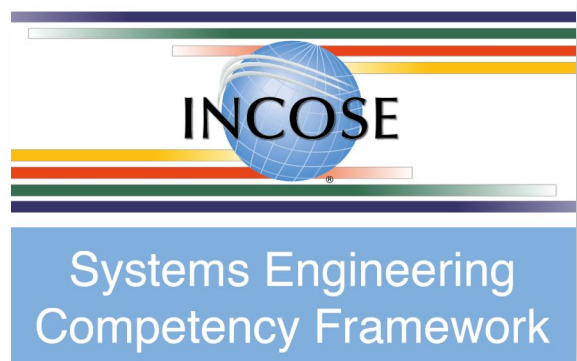
Jennifer Russell
Judy Nolan

Andy Nolan
Tim Pruitt



**THE
GOOD
AND THE
BAD
UGLY**

SEs use Judgement



CORE COMPETENCIES

Core competencies underpin engineering.

Critical Thinking

The objective analysis and evaluation of a topic in order to form a judgement

| | |
|-------------------------------|--|
| Systems Thinking | The appreciation of the concept of a system |
| Lifecycles | Selection of the appropriate lifecycles in the realization of a system; |
| Capability Engineering | An appreciation of the role the system of interest plays in the system of which it is a part; |
| General Engineering | Foundational concepts in mathematics, science and engineering and their application; |
| Critical Thinking | The objective analysis and evaluation of a topic in order to form a judgement; |
| Systems Modeling and Analysis | Provision of rigorous data and information including the use of modeling to support technical understanding and decision making. |



Judgement? Calibrated?

A “Test” for Judgement Calibration

20 question simple test

+ confidence
in answer

Confidence:
0 = no idea
10 = certain

Average confidence
of correct answers

Calibration Factor =
Confidence / Accuracy



Actual Answer is 456 ft

Guesses between 23 ft and 65,617 ft

In feet, how tall is the tallest pyramid of Giza (Egypt)?



Are some people good at judgement?

| Confidence vs % Error | | Confidence Level | | | | | | | | | |
|-----------------------|--------------|------------------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| | | 0 - 10 | 10 - 20 | 20 - 30 | 30 - 40 | 40 - 50 | 50 - 60 | 60 - 70 | 70 - 80 | 80 - 90 | 90 - 100 |
| % Error | -5% - 5% | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | -10% - 10% | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| | -17% - 20% | 1 | 0 | 0 | 3 | 3 | 2 | 3 | 0 | 0 | 0 |
| | -29% - 40% | 0 | 1 | 2 | 6 | 14 | 18 | 4 | 6 | 3 | 0 |
| | -45% - 80% | 2 | 3 | 12 | 21 | 47 | 37 | 15 | 3 | 0 | 0 |
| | -62% - 160% | 1 | 13 | 21 | 50 | 61 | 23 | 9 | 1 | 1 | 0 |
| | -77% - 320% | 5 | 9 | 27 | 33 | 32 | 14 | 6 | 1 | 2 | 0 |
| | -87% - 640% | 1 | 9 | 4 | 21 | 8 | 2 | 2 | 2 | 0 | 0 |
| | -93% - 1280% | 1 | 2 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| | -96% - 2560% | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

Confidence Level: 0 = no idea; 100 = certain

% Error: Guess/correct answer

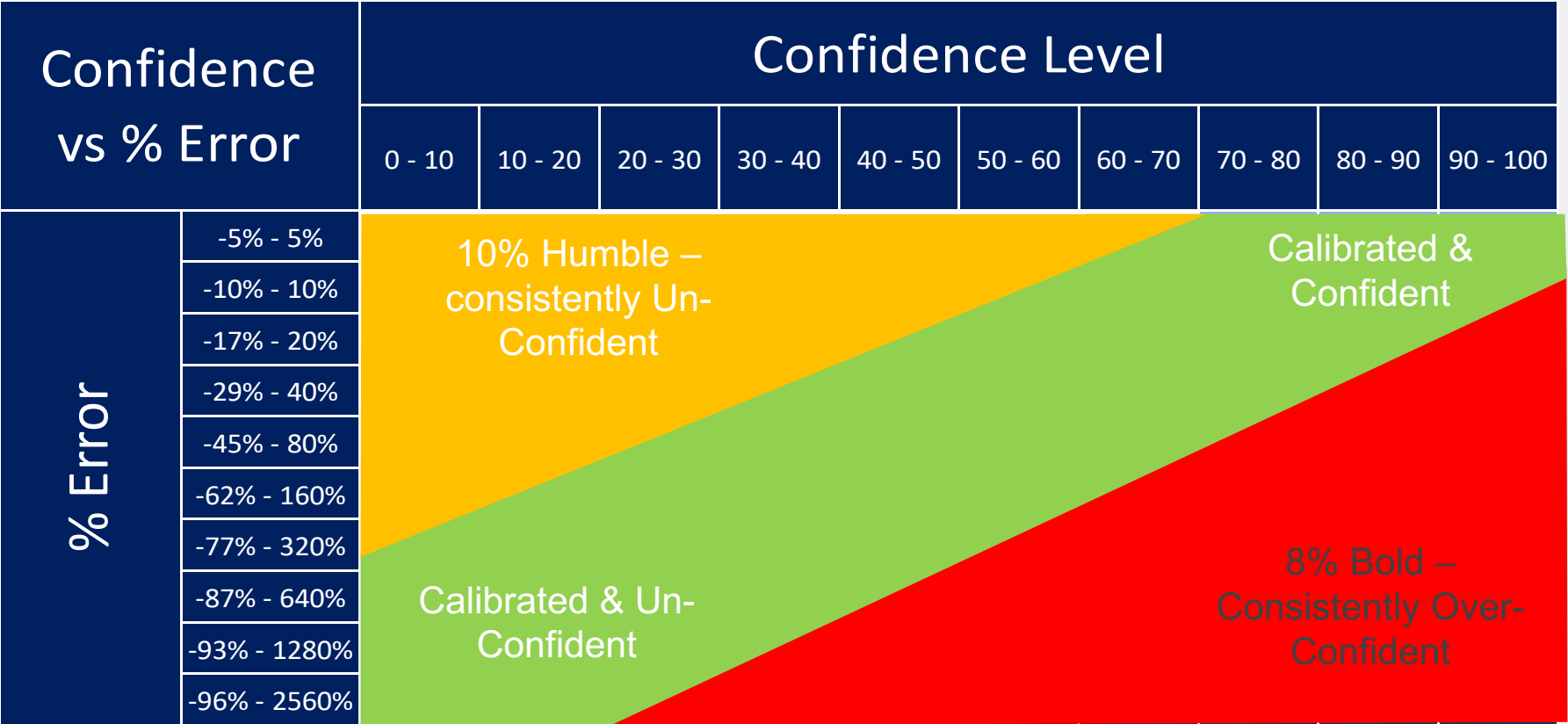
Average Confidence vs average % Error shows a person's consistent level of accuracy.

Consistently Over Confident

Confidence and %Error align

Consistently Under confident

Are some people good at judgement?



Calibrated (Green): 82% were calibrated

Humble (Amber): 10% were better than they thought

Bold (Red): 8% thought they knew but did not

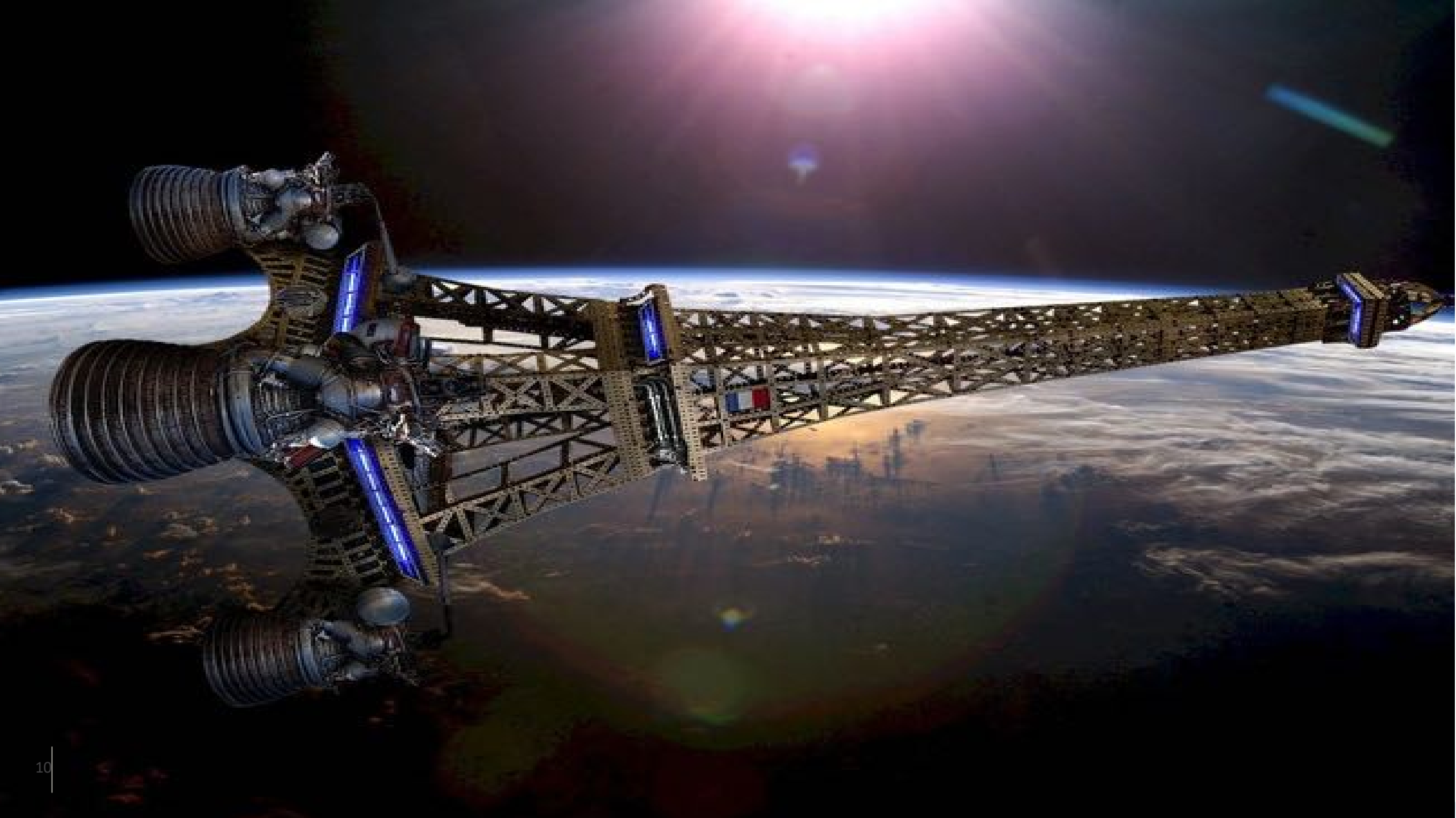


In feet, how tall is the Eiffel Tower in Paris?

Actual height = 980 ft

Guesses between 115 ft and 164,000 ft





| | | Y/N | Conf |
|----|---|-----|------|
| 1 | The Eiffel Tower is taller than the Empire State Building? | Y | 1 |
| 2 | A Tennis ball is bigger in diameter than a Cricket ball | N | 7 |
| 3 | On average cats lives longer than dogs | | |
| 4 | Titanium has a higher melting point then stainless steel | | |
| 5 | More people live in Germany than Japan | | |
| 6 | An Indian elephant can live longer than an African Elephant | | |
| 7 | Ice is more dense than water | | |
| 8 | Rome Italy is north of Beijing China | | |
| 9 | There are 52 states in the USA | | |
| 10 | The deepest point in any ocean is in the Pacific Ocean | | |



| | | Y/N | Conf |
|----|---|-----|------|
| 1 | The Eiffel Tower is taller than the Empire State Building? | Y | 1 |
| 2 | A Tennis ball is bigger in diameter than a Cricket ball | N | 4 |
| 3 | On average cats lives longer than dogs | Y | 7 |
| 4 | Titanium has a higher melting point then stainless steel | N | 6 |
| 5 | More people live in Germany than Japan | Y | 3 |
| 6 | An Indian elephant can live longer than an African Elephant | N | 8 |
| 7 | Ice is more dense than water | Y | 9 |
| 8 | Rome Italy is north of Beijing China | N | 2 |
| 9 | There are 52 states in the USA | Y | 3 |
| 10 | The deepest point in any ocean is in the Pacific Ocean | N | 6 |

Confidence
= 49

Confidence = sum of
your confidence scores

| | | Y/N | Conf |
|----|---|-----|------|
| 1 | The Eiffel Tower is taller than the Empire State Building? | No | |
| 2 | A Tennis ball is bigger in diameter than a Cricket ball | No | |
| 3 | On average cats lives longer than dogs | Yes | |
| 4 | Titanium has a higher melting point then stainless steel | Yes | |
| 5 | More people live in Germany than Japan | No | |
| 6 | An Indian elephant can live longer than an African Elephant | Yes | |
| 7 | Ice is more dense than water | No | |
| 8 | Rome Italy is north of Beijing China | Yes | |
| 9 | There are 52 states in the USA | No | |
| 10 | The deepest point in any ocean is in the Pacific Ocean | Yes | |



| | | Y/N | Conf |
|----|---|-----|------|
| 1 | The Eiffel Tower is taller than the Empire State Building? | Y | 1 |
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Accuracy =
 $2 * 10 = 20$

Accuracy is the number
of correct questions *
10

| | | Y/N | Conf |
|----|---|-----|------|
| 1 | The Eiffel Tower is taller than the Empire State Building? | Y | 1 |
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Confidence = 49

Accuracy = 20

Calibration factor
= 49 / 20 = 2.5

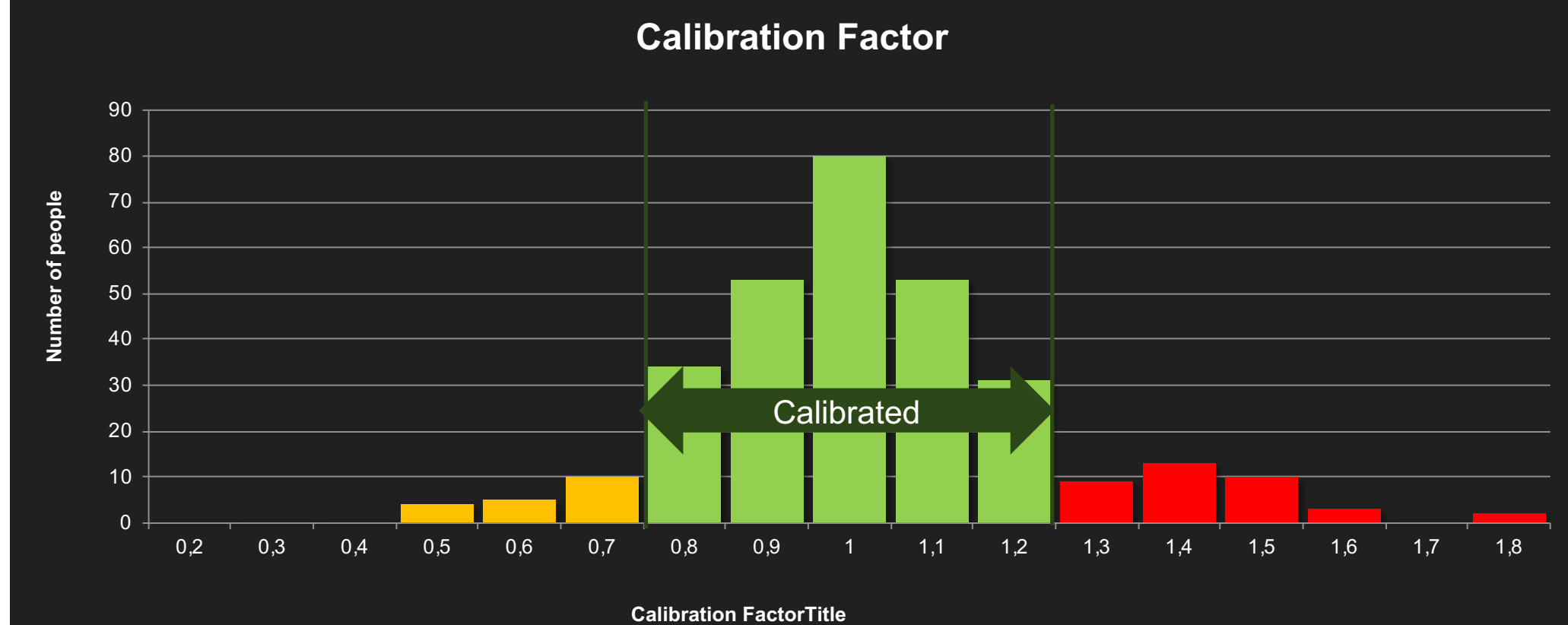
Calibration Factor =
Confidence / Accuracy



Calibration Factor =
Confidence / Accuracy



Calibration
Factor =
 $\frac{\text{Confidence}}{\text{Accuracy}}$



↓ Confidence
↑ Accuracy

Humble
Calibration Factor
< 0.8.

→ Confidence
→ Accuracy

Calibrated
Factor
0.8 - 1.2

↑ Confidence
↓ Accuracy

Bold
Calibration Factor
> 1.2

How tall is Leaning Tower of Pisa?

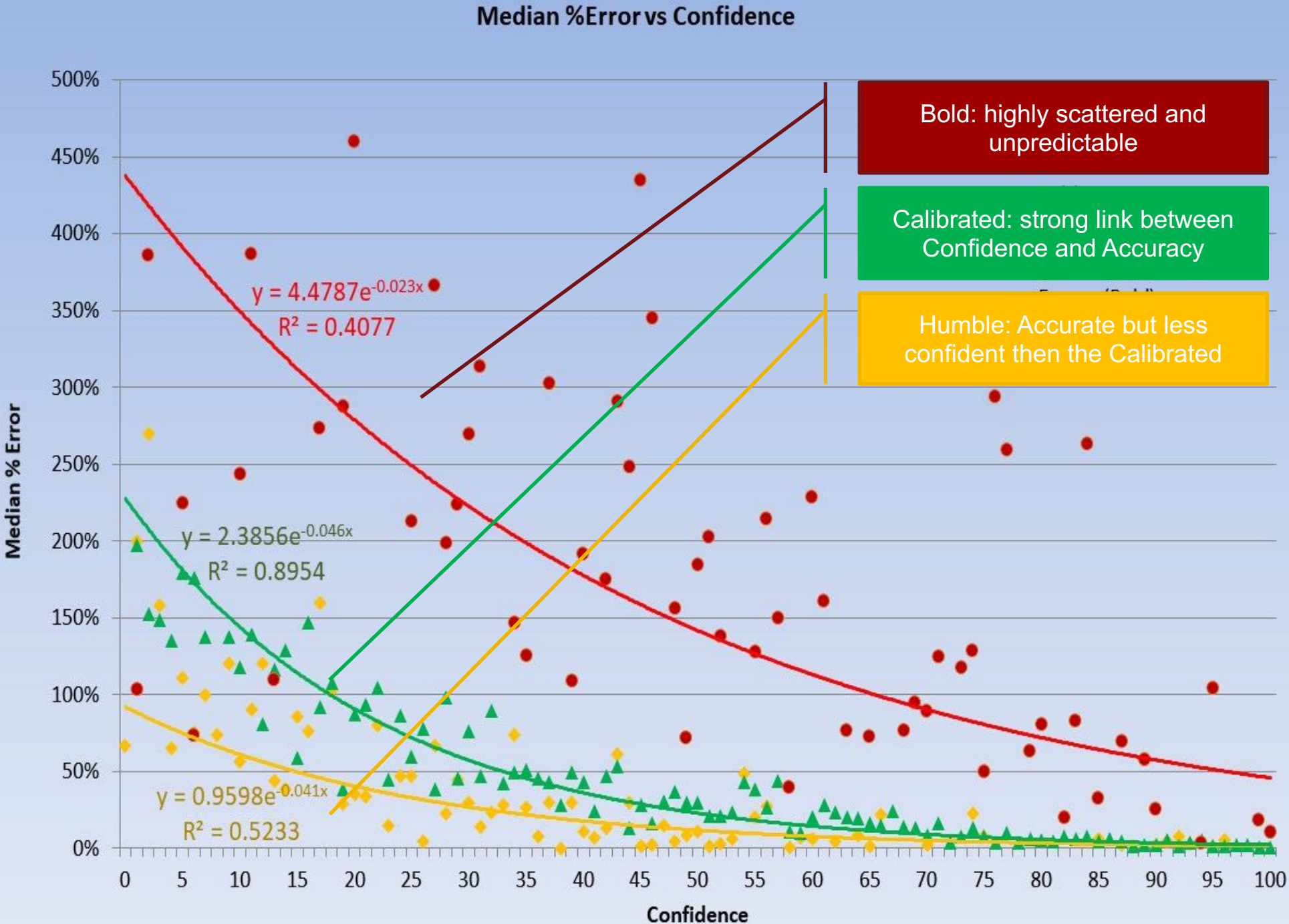
Actual height = 184 ft

Guesses between $6\frac{1}{2}$ ft and 1,000 ft!

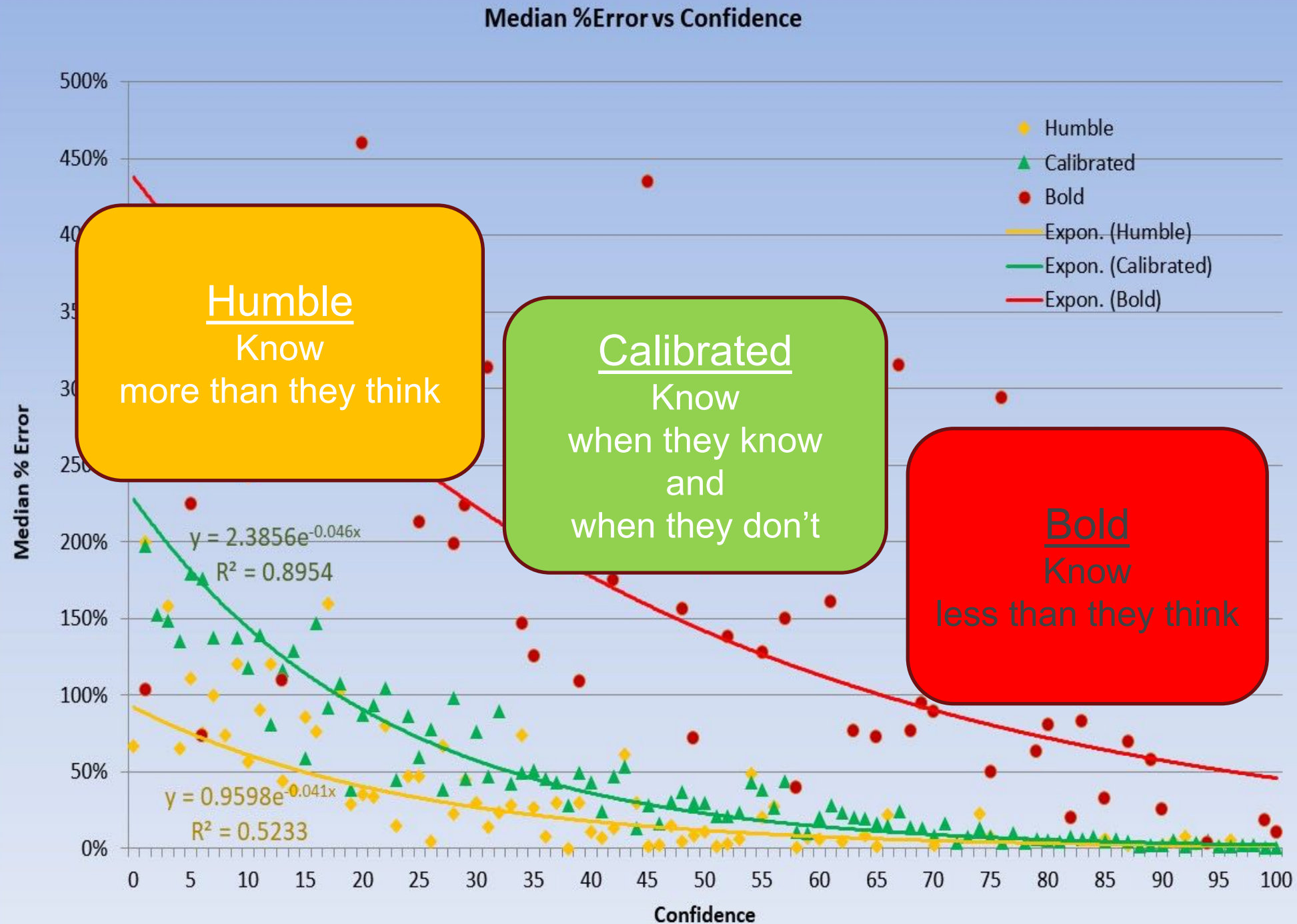




The Bold, the Humble and the Calibrated



What does this mean?



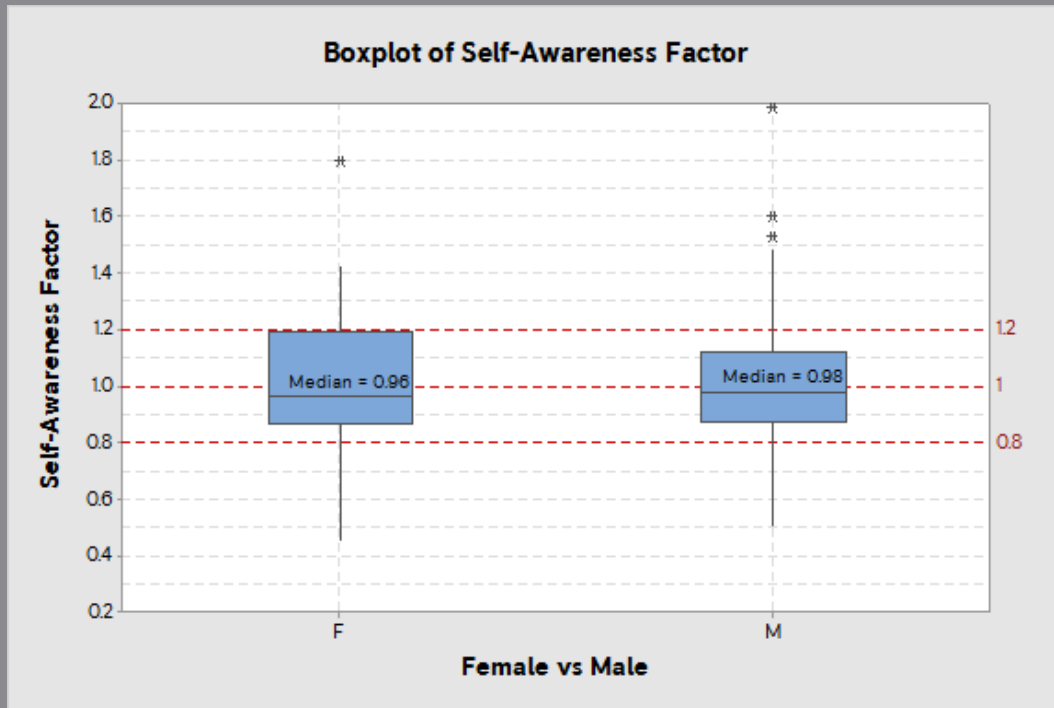
In feet, how tall is Big Ben?

Actual height = 315 ft

Guesses between 50 ft and 50,000 ft!



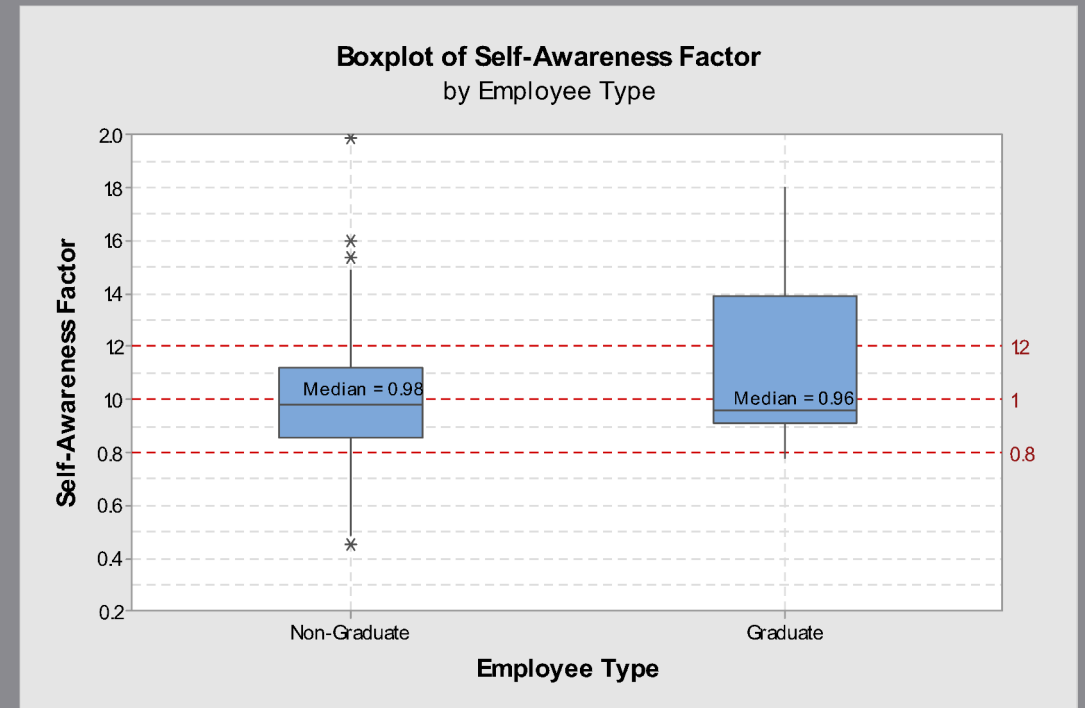




Female vs Male

Calibration – No statistical difference

No bold tendencies

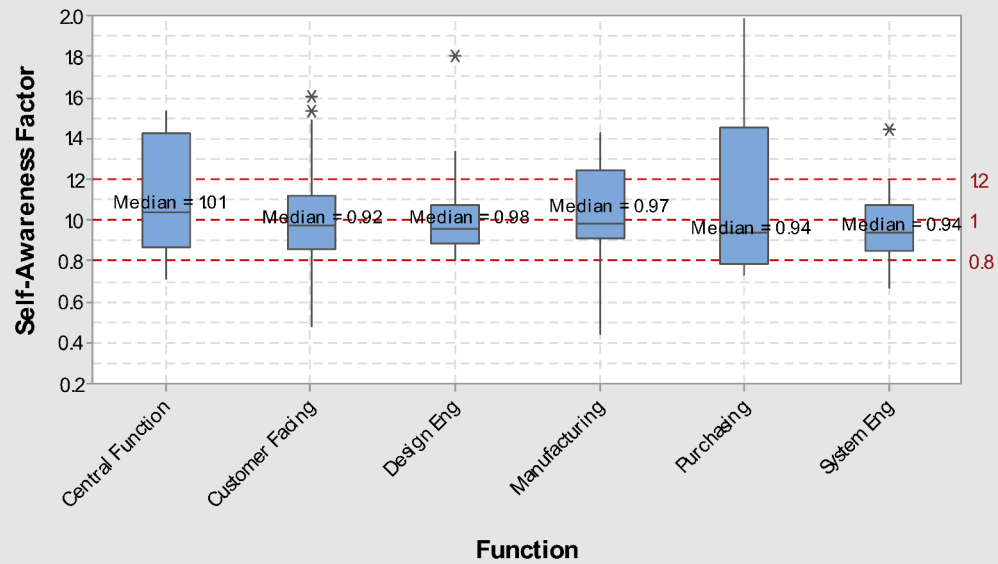


Non-Grad vs Grad

Calibration – No statistical difference

Grads have **bolder** tendencies

Boxplot of Self-Awareness Factor by Function

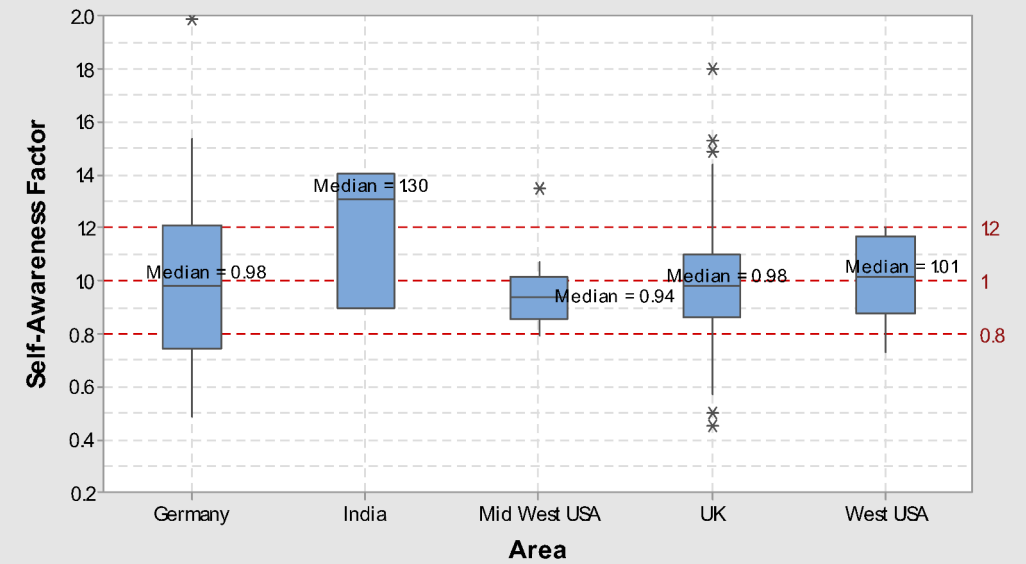


Work Function

Calibration – Greater range among Headquarters and Purchasing staff

Headquarters and Purchasing lean Bolder

Boxplot of Self-Awareness Factor by Geographical Area



Geographical location

Calibration – Greater range for Germany and India

India leans Bolder; mid-west USA predominantly Humble

Take test 1,
read results
and then
re-calibrate

Take test 2,
read results
and then
re-calibrate

Take test 3,
read results
and then
re-calibrate

Self Awareness Scores after completing repeated tests





Managing by Calibration

| | Humble | Calibrated | Bold |
|-------------------|--|--|--|
| Score | < 0.8 | 0.8 – 1.2 | > 1.2 |
| Behaviors | Reluctant to speak Take a long time to do work Let others lead | Speak when confident Quiet when not | Actively speak Regularly take lead Good presenters |
| Management | Encourage | Trust | Moderate |



Application of Calibration

| | <u>Humble</u> Calibration Factor < 0.8 | <u>Calibrated</u> Calibration Factor between 0.8 and 1.2 | <u>Bold</u> Calibration Factor > 1.2 |
|---------------|---|---|---|
| Enterprise | Pair with Calibrated | Use as Subject Matter Experts | Use energy and balance with Calibrated |
| Team | Champion these people | Is this your leader? | Is this your leader? |
| Environmental | Geographical? | Training? | Business Domain? |

A silhouette of a city skyline, likely Cairo, Egypt, featuring the Great Pyramids and the Sphinx. The scene is set against a vibrant sunset sky with a large, bright sun. Birds are flying in the sky, and the entire scene is reflected in the water in the foreground.

How long is the Nile River?

Actual distance 4,179 miles

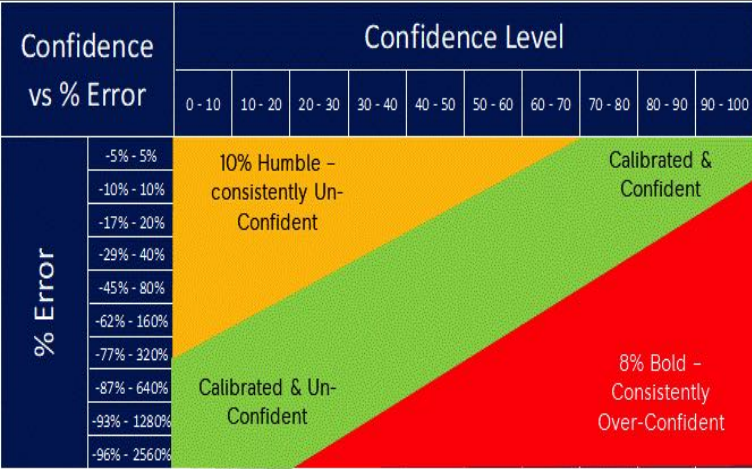
Guesses between 4 miles and 415,000 miles

415,000 miles
would loop the
world
seventeen
times!

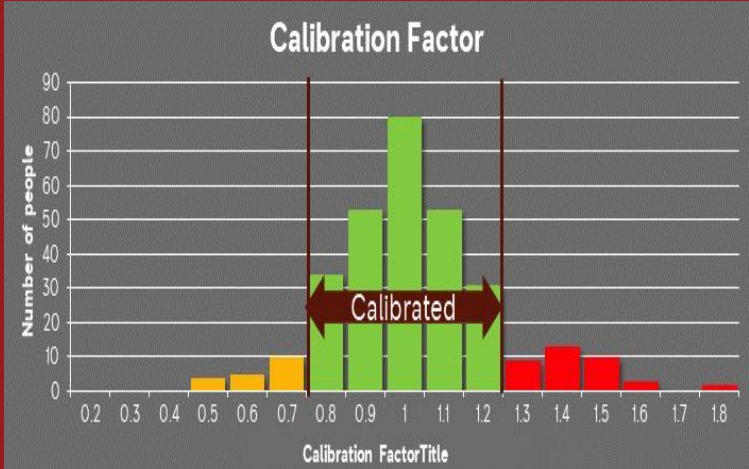


Conclusions

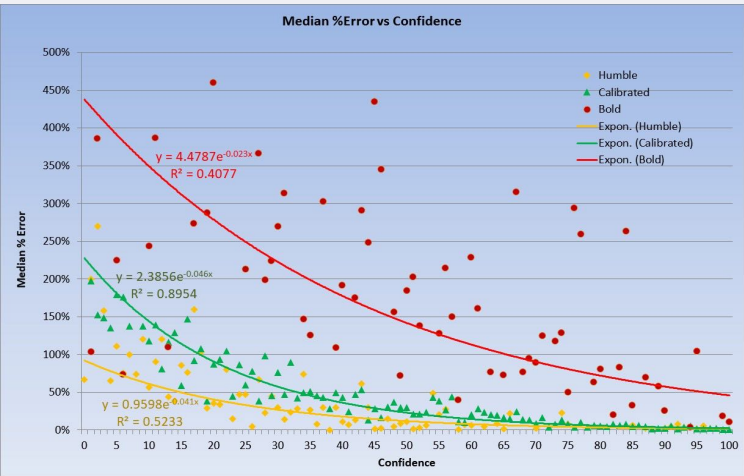
1 Not everyone is good at judgement



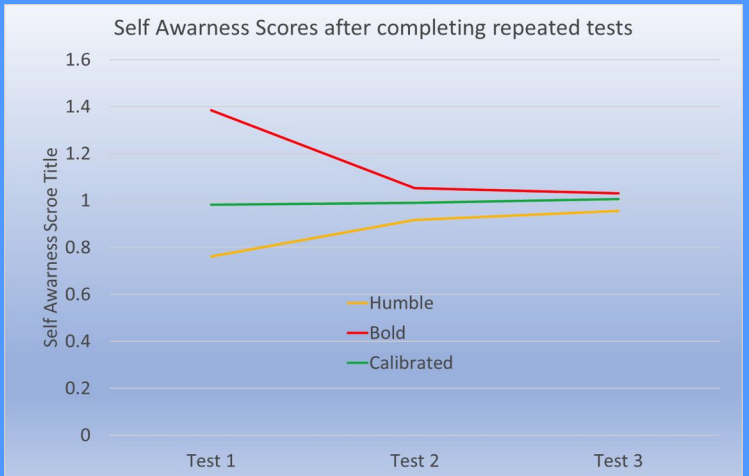
2 Calibration = Confidence / Accuracy



3 Accuracy = Confidence * Calibration



4 Calibration can be learned





In lbs, how heavy can a fully grown African elephant get?

Actual = 11,000 lbs

Guesses between 10 lbs and 110,000 lbs

10 lbs is about the same
weight as a slightly plump cat!





Questions?

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Calibration Test?

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