Approaches for Estimating Activity Durations & Probabilities:[1] An Assessment

Dr. Kenneth F. Smith, PMP

We Dig Deep, While Others Sleep
Ways of Working for Project Professionals

Background. The impetus for this article was Dr. Paul Giammalvo's admonition in the January 2026 PMWJ to **STOP USING PERT** because it does not meet the 5 attributes of the Scientific Method, and there are no results showing its consistent successful application; so it is *'nothing more than an unsubstantiated marketing claim'*.[2] Given his considerable experience in project management as a contractor & asset owner, as well as continuing to be a serious scholar and world-wide teacher / mentor, I do not treat Paul's perspective lightly.

However -- *as I expressed in my February 2026 rebuttal* [3] -- from my experience as a career-long *'hands-on'* PERT-practitioner, government employee & consultant for various governments and international agency-sponsored projects, the fundamental flaw with PERT was not its formula, but ***rather misapplication*** by those using it. Although unable to cite projects attributing their success to PERT, I also question whether ***any*** time-estimating planning technique could be the ***principal*** *cause-effect* for subsequent schedule success -- *or slippage* -- in the largely uncontrollable VUCA[4] project management environment.

Paul's second strike was for **PERT to be replaced with Excel-*based* or** even more sophisticated statistical **Monte Carlo simulation software** that can incorporate skewness, to generate more realistic profiles and probabilities for planning.

While no longer a practitioner; during semi-retirement I have continued to share my waning knowledge, experience -- *and opinions* -- through PMWJ, as well as in intermittent seminars & workshops. However, provoked by Paul, I stirred from my comfort zone to re-examine the concepts, structure and process underlying PERT *vis a vis* other schedule-planning approaches for estimating project activity durations; as well as to update myself regarding the utility of Monte Carlo's iterative simulation approach as another technique and tool for project planning, monitoring & management.

Here are my findings, as well as the review process and data on which they are based.

[1] How to cite this article: Smith, K.F. (2026). Approaches for Estimating Activity Durations: An Assessment. *PM World Journal*, Vol. XV, Issue IV, April.

[2] Giammalvo, P. D. (2026). What Do We Do AFTER Calculating Our Average Costs or Durations? PM World Journal, Vol. XV, Issue I, January. https://pmworldlibrary.net/wp-content/uploads/2026/01/pmwj160-Jan2026-Giammalvo-what-we-do-after-calculating-averages.pdf

[3] Smith, K.F. (2026). In Defense of PERT-PLUS. PM World Journal, Vol. XV, Issue II, February. https://pmworldlibrary.net/wp-content/uploads/2026/02/pmwj161-Feb2026-Smith-in-defense-of-PERT-Plus-2.pdf

[4] VUCA: **V**olatile, **U**ncertain, **C**omplex, **A**mbiguous

INTRODUCTION

Risks of different types and magnitude exist in every project's working environment, from the availability of resources depending on the project's technology level; their capability & related costs; logistical constraints to service the participants on the job; as well as management's power, authority, & administrative capacity to facilitate despite inherent bureaucratic bulwarks, both internal and governmental. Thus, extensive interactive consideration is needed for making sound estimates of numerous activity durations -- by project planning personnel with operational subject matter specialists, resource managers, administrators and executives -- to determine the likelihood of attaining any proposed Project Schedule. However, obtaining sufficient knowhow is not always feasible, nor adequate information always readily available *a priori* to the level of detail desired.

Most program sectors, and their subject matter experts (SMEs) already have standard operating procedural guidelines, formulas &/or 'rules of thumb' to estimate time durations -- with related costs -- for some aspects of their work; gleaned from prior experiences. Nevertheless, unlike factory production lines where processes and procedures are coordinated, integrated and fine-tuned to 'just-in-time' perfection; projects are mostly 'one-offs', where a considerable amount of uncertainty with respect to duration and timing still persists in the planning environment.

In some instances, internally-imposed executive deadlines &/or demands, or external customer-desired deliveries may leave little or no option but to proceed -- *despite inadequacies and uncertainties* -- then do one's best to comply. But the more rational approach is to first assess whatever **is** available, weigh the alternatives; then plan the scope; confirm the budget likely to be available, and schedule accordingly.

To address the uncertainty of estimating individual activities, the following three 'three-point' techniques have been widely used over the years to address them; with formulas -- and more recently computer software -- to facilitate their computation:

1. **A simple Arithmetic Average** of the Three Point Range, *aka* a Triangular Approach
2. **A 'Normal' Curve, with statistical 'Standard Deviations'** to estimate Probability
3. **The Program Evaluation & Review Technique (PERT)** utilizing a Weighted Mean to calculate an 'Earliest Expected Time' and derive Probability from an '*Estimated* Standard Deviation'

Nevertheless, formulas are merely generic tools; and while useful, their results are the output from best guesses – rather than actual result data. Moreover, until after-the-fact, there is no way to determine which estimating approach is 'Best' -- *i.e. More Accurate* -- for an activity in a particular sector, situation or user. Hence the acronym GIGO for the adage "Garbage In; Garbage Out!"

The following discourse outlines my review and findings for each of the preceding approaches; and to facilitate comparisons between them, I have utilized these three values throughout:

10 days = **Optimistic** (Best Case)
20 days = **Most Likely** Case
70 days = **Pessimistic** (Worst Case)

[**NOTE**: Some view Best & Worst Cases as Specific durations; others merely as Extremes in a Range]

PART I
TECHNIQUES FOR ESTIMATING SINGLE ACTIVITY DURATIONS

1. The Arithmetic Average

The Arithmetic Average is more commonly simply called an Average.
In more formal statistical use, it is called a "**Mean**'.

This is a '*quick & easy*' approach. Simply total the three values; divide by 3, and use the Average

10 + 20 + 70 = **100**
100 / 3 = **33.3** or **34 days**, rounded up.

This approach merely attempts to factor in the considerable uncertainty expressed by the pessimistic outlier, in this case 70. However, while an Average is a 'balance point' for the range of data provided, **it does not represent a 50% likelihood of occurring, nor is it capable of providing the probability of any value occurring.**

Thus, Averaging is not a serious contender for further consideration or examination.

To obtain Probability values related to Activity duration estimates, further statistical analysis is necessary; the key to which is the **'Standard Deviation'.**

To minimize confusion, before proceeding further, here is a reference to the terminology frequently utilized in subsequent analyses; with some additional explanation:

Mean = The **Arithmetic Average**

Median = The **Midpoint** in a **series of values,** ranked from 'Low to high', or 'High to Low' without regard for their actual values

Mode = The **Most Frequently Occurring Value** in a set of data

NOTE: In three-point data sets for estimating activity durations, the 'Most Likely' value is *both* the Median and the Mode.

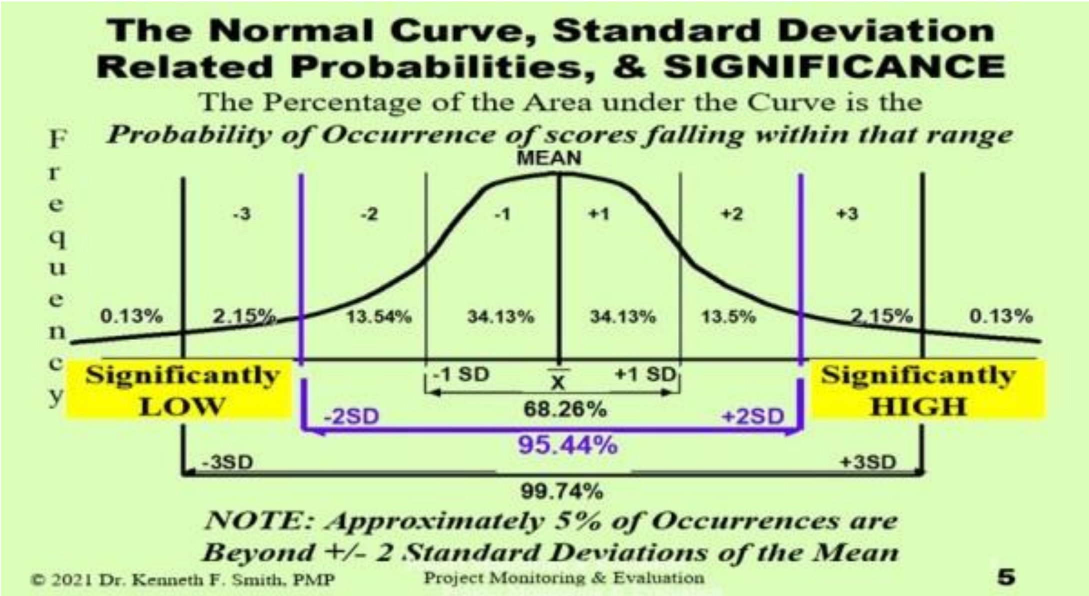
Normal Curve = A **symmetrical bell-shaped graph** of a data-set where the mean, median & mode **are all equal** at the highest point.

NOTE: For our purposes, with three-point data sets for estimating activity durations, the cumulative Probability of the Mean value in a Normal Curve is 50%.

Standard Deviation = A Fixed interval from the Mean of a **Normal curve.**

Conceptually: Value percentages are equal to the area under the curve.
An illustrative Normal Curve with Standard Deviation values and related Probabilities is shown in Figure 1, below

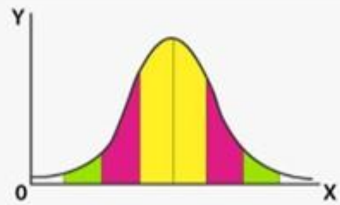
FIGURE 1



NOTE: For our purposes, the Probability of any value under consideration for activity assignment can be estimated by the size of its Standard Deviation.

Statistically: The square root of the sum of all the variances.

Standard Deviation Formula



$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{N}}$$

Don't worry about the symbols & formulas for calculating the Probability of intermediate values. Just *'Get'* the Standard Deviation concept! Excel can calculate the results for you.

However, if you ***are*** a worrywart, see the more detailed explanation in Figure 2.

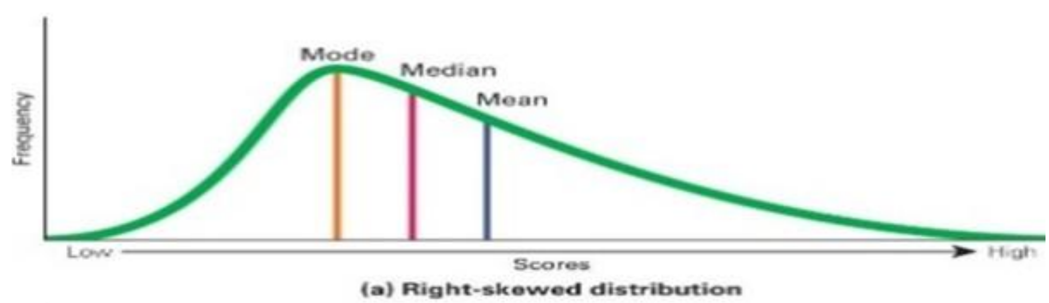
FIGURE 2

COMPUTING THE STANDARD DEVIATION -- THE PROCESS						
	1. DATA VALUE	4. MEAN	5. DATA MINUS MEAN	6. DATA MINUS MEAN SQUARED		
OPTIMISTIC Estimate	10	33.3	-23.3	544.4		
MOST LIKELY Estimate	20	33.3	-13.3	177.8		
PESSIMISTIC Estimate	70	33.3	36.7	1344.4		
N *is Number of Data Items =*	3					
2. SUM of Data Values	100	7. SUM of Squared Data		2,066.7		
3. SUM Divided by # of Data Items *(3 in this case)* = MEAN	33.3	8. Divide Squared Dats Sum by N				10. CHECK: *SHOULD BE*
				688.9		
9. RESULT: THE STANDARD DEVIATION OF A SET OF DATA VALUES IS THE SQUARE ROOT OF THE DIVIDED SUM=			SQRT	26.25		26.25

NOTES: Step 6: The *'Data minus the Mean'* Results are Squared to eliminate any Negative Values. Step 9: The Square Root is then taken to Restore the Resulting Value to conform with the Step 1. INPUT Data Value Level. Step 10. Compares the 'MANUAL' process with the Excel computed formula =STDEV.P(*The value of each individual data item in the formula is represented by X_i repeated in the computation and as shown in the worksheet above*)

Skew is when some values are 'outliers,' thereby conceptually distorting the bell curve so it is no longer symmetrical.
NOTE: In a **Right Tail Skew,** the Mean is to the Right of the Mode & Median:

FIGURE 3
HIGH-RISK CONCEPTUALLY-SKEWED CURVE



NOTE: Unlike the generic situation depicted above, in our three-point estimate the Median is the ***same*** as the Mode**; but** dubbed the **'Most Likely'** value, while the Pessimistic value is the outlier.

Z-Score = (Value – Mean) / Standard Deviation.

This formula is used with an Excel Standard Deviation 'Lookup Table' to determine a **Value's Probability**. For Example,

DATA VALUE *'T&E'* TABLE FOR Z SCORE & PROBABILITY

A	B	C	(A - B)/C
VALUE YOU WANT	MEAN	1 Standard Deviation	Z SCORE
40	33.3	26.25	0.26
PROBABILITY =		60%	FALSE

FYI: Here's a portion of an Excel Standard Deviation Probability 'Lookup Table'

Standard Deviation Lookup Table				OFFSET
				5
NORMAL CURVE & RELATED PROBABILITY				
Z Score	Above		Below	Probability
z		probability	z	prob
0		0.5	0	0.5
0.01		0.5	-0.01	0.5
0.02		0.51	-0.02	0.5
0.03		0.51	-0.03	0.49
0.04		0.52	-0.04	0.48
0.05		0.52	-0.05	0.48
0.06		0.52	-0.06	0.48
0.07		0.53	-0.07	0.47
0.08		0.53	-0.08	0.47
0.09		0.54	-0.09	0.46
0.1		0.54	-0.1	0.46
0.11		0.55	-0.11	0.45
0.12		0.55	-0.12	0.45
0.13		0.56	-0.13	0.44
0.14		0.56	-0.14	0.44
0.15		0.56	-0.15	0.44
0.16		0.56	-0.16	0.44
0.17		0.57	-0.17	0.43
0.18		0.57	-0.18	0.43
0.19		0.58	-0.19	0.42
0.2		0.58	-0.2	0.42

2. The Normal Curve

Utilizing the three values: **10** days **Optimistic, 20 Most Likely** & **70** days **Pessimistic** in Excel's formula **=STDEV.P(10+20+70)**

The Mean is **33** and the computed standard deviation is **26** (data rounded); thus

-3 SD*	-2 SD*	-1 SD	Mean	+1 SD	+2 SD*	+3 SD*
-45	-19	7	33	60	86	112
0%	2%	16%	50%	85%	98%	100%
Probability						

Assessment

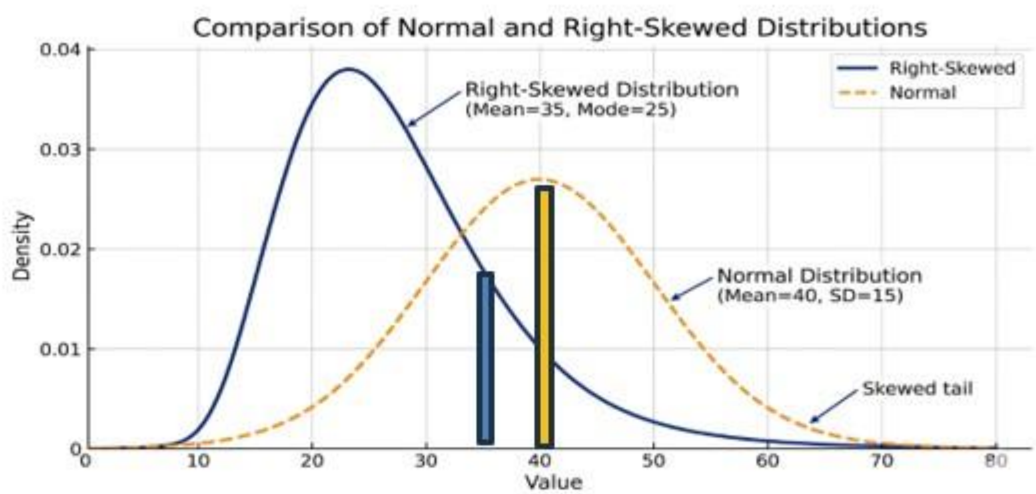
1. Despite the skew, the Normal Distribution only assigns Equal but Opposite Probabilities to Values on Both sides of the Curve within a given number of Standard Deviations from the Mean. **This *prima facie* is unrealistic, especially for Highly Skewed data values.**

2. Although computationally correct, some computed values ** are beyond the original Estimated Optimistic and Pessimistic Ranges, as well as implausible.

3. The probability for the Value at **2** standard deviations has been ***marginally inflated* from 95% to 98%**

Cause, & Effect: In Right-Skewed data distributions – *with which we are dealing* -- the Mean is no longer superimposed on the Mode & Median, but closer to the direction of the skew.

FIGURE 4



As depicted above, relocation increases outlier value probabilities while concurrently decreasing probabilities of values to the left of the curve's Mean. Hence, the further the outlier from the Mode, the greater the distortion.

3. The PERT Approach

During the late 1950's an attempt was devised to offset the drastic right shift and distortion incurred by the Normal Distribution Curve:- the Program Evaluation & Review Technique. The distinctive modifications by PERT for a single activity were as follows:

1. The Most Likely value was weighted – *apparently arbitrarily* – by **4.**
   Thus, the **Mean** was derived by dividing with **6** instead of 3,
   and was redesignated the **Earliest Expected Time (EET).**

   $$\frac{(O+4ML+P)}{6}$$

2. The Normal Curve Standard Deviation was supplanted by a unique '***Estimated'* Standard Deviation** equal to **1/6th of the Range**.

   $$(P-O) / 6$$

   The **Result,** using **Optimistic 10** days**, Most Likely 20,** & **Pessimistic 70** days is a **27** "Earliest Expected Time" and an Estimated Standard Deviation of **10;** thus

-3 ESD	-2 ESD	-1 ESD	EET	+1 ESD	+2 ESD	+3 ESD
-3	7	17	27	37	47	57
0%	2%	16%	50%	85%	95%	100%
Probability						

Assessment

1. The Range divided by **6** – *i.e. plus weighted values* -- produces a smaller Mean.
2. With a smaller EET (i.e. Mean) closer to the Most Likely value, the influence of outliers is reduced.
3. Truncating the Standard Deviation creates an analytical 'straitjacket' where the results are mostly confined to the original Range under consideration. [In reality, while there are physical limitations to how quickly an activity can be performed, there is no upper to how long it might take. Thus, actual completion may be way beyond the Pessimistic value.]
4. Nevertheless, despite using a smaller Standard Deviation, PERT continued to utilize the Normal Z-Score & Probability Protocol.
5. The Net Effect of applying PERT is higher Probabilities for the same Values**.**
6. Moreover, *DESPITE the SKEW,* both Optimistic and Pessimistic Values are still *EQUALLY DISTRIBUTED* on either side of the Bell Curve.

At this juncture I should point out that many managers perceive the Mean, Earliest Expected Time, &/or 'Most Likely' time as . . . *well* . . . the *MOST LIKELY TIME,* and knowingly prefer to apply it as the activity's duration.

I used to recommend they consider using a value closer to 95% probability (i.e. 2 standard deviations); pointing out that 50% is the equivalent of tossing a coin, or playing Russian Roulette with three bullets; and that regular Russian Roulette actually has better odds of survival – *5/6th i.e.* ***83%.*** But 'Modal' managers regard **cumulative** probabilities as inappropriate, and standard deviations as too theoretical; and disdainfully differ. Instead, they customarily retorted – with equal ardor, ***and more authority*** -- that rather than a *range* of possibilities, the Optimistic, Most Likely & Pessimistic values were ***stand-alone*** possibilities.

Much like a six-sided die with weighted frequencies,

10	**20**	**20**	**20**	**20**	**70**

their unequivocal choice was the Most Likely; 4/6th, or ***67%*** percent; preferring to defer pessimistic estimates as a terminal contingency or Management Reserve. And how often we do the same in our personal lives!

Indeed, Eli Goldratt also advocates this approach in his **Critical Chain Method (CCM)**; and relegate the *time component* of all Critical Path-related activity risks to a collective '*Project Buffer*' *AFTER* the last project activity.[5] [**NOTE:** Goldratt successfully utilized the **Theory of Constraints (TOC)** technique to improve scheduling efficiency in production line flow-through, and logistical supply chain replenishment.]

I acknowledge the value of CCM in those types of situations[6] -- as well as most military operations -- where just-in-time is of the essence, and ASAP is critical to the mission outcome. However, for most project scenarios, IMO pre-planning stable milestones -- *allocating buffer to activities* -- is preferable to the inevitable knock-on 'domino effect' from endless downstream milestone re-scheduling during project execution, that creates chaos as well as unnecessary stress.[7]

[5] Goldratt E. M. What is this thing called the theory of constraints? NY: The North River Press, 1990.

[6] Smith, K. F. (2023). On Critical Chain Scheduling & Buffering: A Critique on the Theory of Constraints as Applied to Project Management, advisory article, *PM World Journal*, Vol. XII, Issue I, January.

[7] See also: Smith, K. F. (2025). Slipped Schedules, Touch-Time, and Black Elephants! Advisory article, *PM World Journal*, Vol. XIV, Issue II, February.

4. Inverse Triangular Distribution

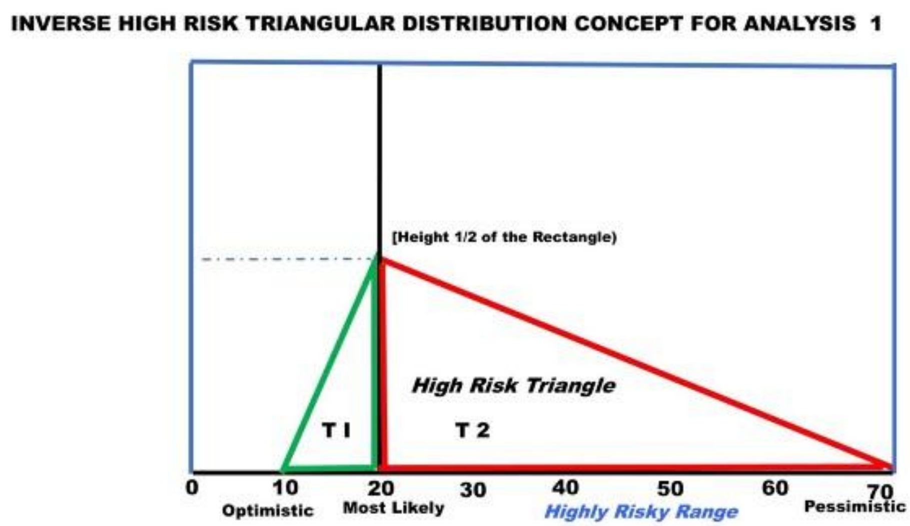
Frustrated at finding flaws in the PERT formula, while searching on-line for information about Monte Carlo I became aware of yet another approach. This was an Excel application called **Inverse Triangular Distribution**; a geometric-estimating model propounded by Dr. Dawn E. Wright[8]; as explained in an article by Sanzio Castor[9], as well as subsequently another article by Joe Domaleski.[10]

Although nowhere as easy to adapt as claimed -- *at least for me* -- Dr. Wright's discussion was nevertheless conceptually comprehensible for improving the estimation of Activity Durations and calculating their related Probabilities. While premature to my investigation of Monte Carlo; I paused that quest to consider the Triangular methodology as a potential procedure to supersede PERT.

Here is what I gleaned from Dr. Wright's approach, and my subsequent adaptation.

STEP 1. Conceive adjacent, opposed, right-angled triangles of different dimensions, with their bases as the ranges of the optimistic & pessimistic estimate values, with their Most Likely value as the common height.

FIGURE 5



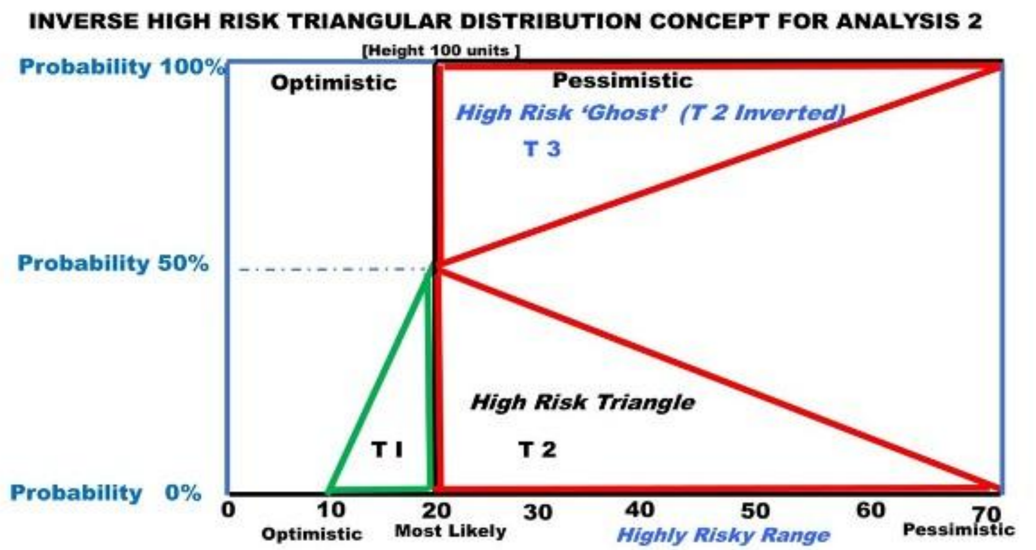
[8] Dr. Dawn E. Wright www.drdawnwright.com Google Search

[9] Sanzio Castor "Easy Inverse Triangular Distribution for Monte Carlo Simulation". Google Search

[10] Joe Domaleski "How to Model Best Case, Worst Case, and Probable Case with the Triangle Distribution" Marketing Data Science

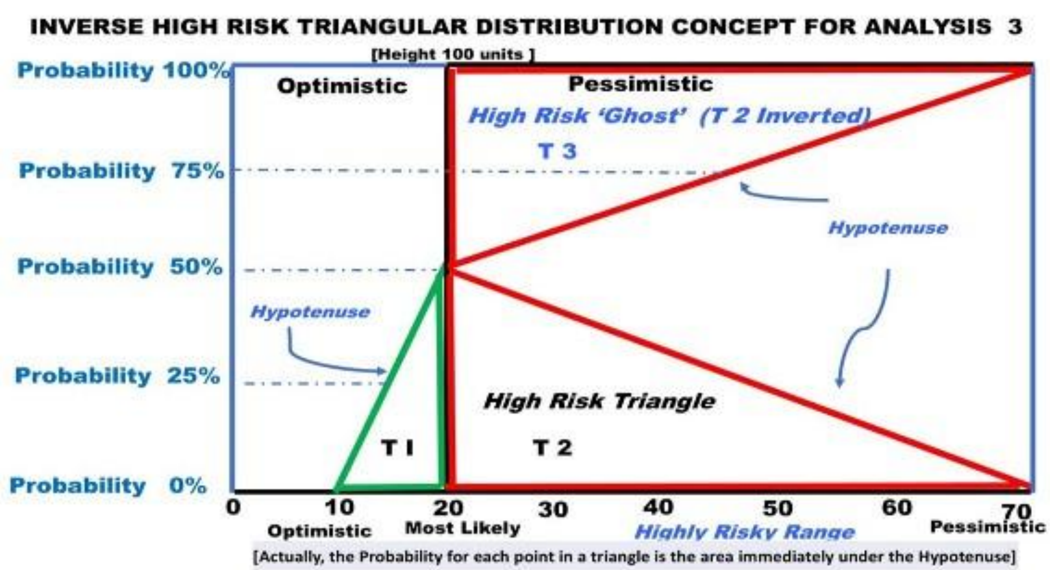
STEP 2. Conceptually, **1.** Flip the graph to Plot an Inverted 'Ghost' Triangle, Then **2.** Add a Probability Scale to the 'Y' axis on the left of the RECTANGLE. The midpoint of the rectangle height is now 0.50 or 50%

FIGURE 6



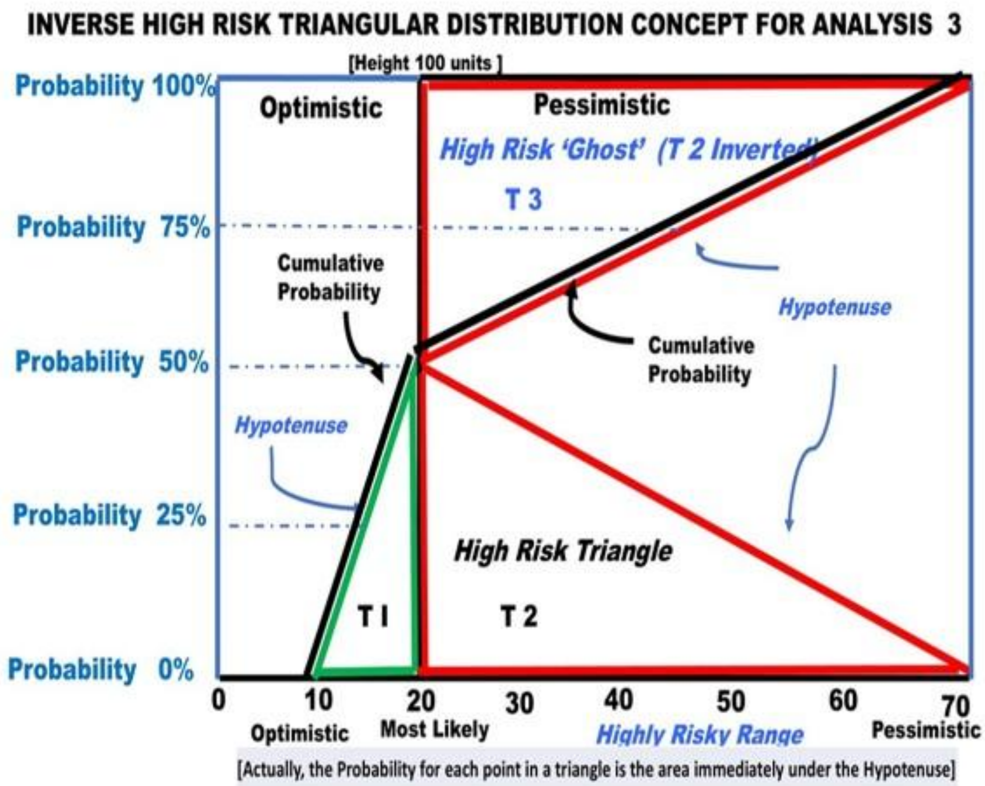
STEP 3: Find the ***Proportionate*** Probability for each Triangle's Hypotenuse values

FIGURE 7



STEP 4 Calculate the CUMULATIVE PROBABILITY for each Value in the Range

FIGURE 8



Optimistic Triangle T1 with a Base Value of 10 (20-10) & Height of 50, the Hypotenuse is 50.99. So for each 1.02 unit of the hypotenuse there is a 1% increase in Height; and a 5% increase for each Base Value. Similarly, for the Pessimistic Triangle T2, with a Base Value of 50 (70-20) & Height of 50, the Hypotenuse is 70.71. So for each 1.41 unit of the hypotenuse, there is a 1% increase in Height; and a 1.01% increase for each Base Value,

OR TO GET THE PROBABILITY PERCENTAGE FOR EACH UNIT .
SIMPLY DIVIDE THE HEIGHT BY ITS BASE!

T1 = 50/10 = 5%   T2 = 50/50 = 1%

A table can easily be developed from these data.

Dr. Wright's triangular analogy and procedure -- which I extracted and paraphrased from her article – was then to continue, using the following nested Excel formulas to compute the Probabilities of Values for Triangles A (T1) & B (T2): Optimistic Value=A, Most Likely Value=B, and Pessimistic Value=C

=IF(RAND()<=(C-A)/(B-A),A+SQRT(RAND()*(B-A)*(C-A)),B-SQRT((1-RAND())*(B-A)*(B-C)))

Dr. Wright then prepared a Cumulative Distribution Function (CDF) Table & Graphic, 'looked up' to provide the probability for any estimated Value – ***from 5,000 random iterations of the input data with the formula.***

After further enlightenment from an article by Zach Bobbitt of Statology,[11] I was able to prepare a similar Table for Dr. Wright's Approach; and combining the Values in one Cumulative Graphic for review &/or look-up. **However, at this stage I only used a deterministic 'single shot'**

FIGURE 9

'THE 'WRIGHT WAY' DATA TABLE COMBINING T1 & T2
***LOW TO HIGH* FOR A SINGLE SHOT**

		DATA	Cum Dist	Cum Dist/2	Cum PROB	Overall	MEAN	33	j96	ST DEV	26	m96
OPT		10	0.159	0.079	8%	ENTER T1 DATA						
		11	0.212	0.106	11%	T1	MEAN	15		ST DEV	5	
		12	0.274	0.137	14%	Opt	10	j98			m98	
		13	0.345	0.172	17%	ML	20					
		14	0.421	0.210	21%							
		15	0.500	0.250	25%							
		16	0.579	0.290	29%	T2	MEAN	45		ST DEV	25	
		17	0.655	0.328	33%	ML	20	j103			m103	
		18	0.726	0.363	36%	Pess	70					
	ROW	19	0.788	0.394	39%							
OPT	107	20	0.841	0.421	42%		END OF TI DATA					
PESS	108	20	1.000	0.500	50%	START T2 DATA: NOTE MODIFIED Formula at ROW E108						
		21	1.010	0.505	50%		ADD: "+$E$107" TO THE FORMULA IN THE CUMULATIVE DISTIBUTION COLUMN					
		22	1.020	0.510	51%							
		23	1.031	0.515	52%							
		24	1.042	0.521	52%							
		25	1.053	0.527	53%							
		26	1.065	0.532	53%							
		27	1.077	0.539	54%							
		28	1.090	0.545	54%							
		29	1.102	0.551	55%							
		30	1.116	0.558	56%							

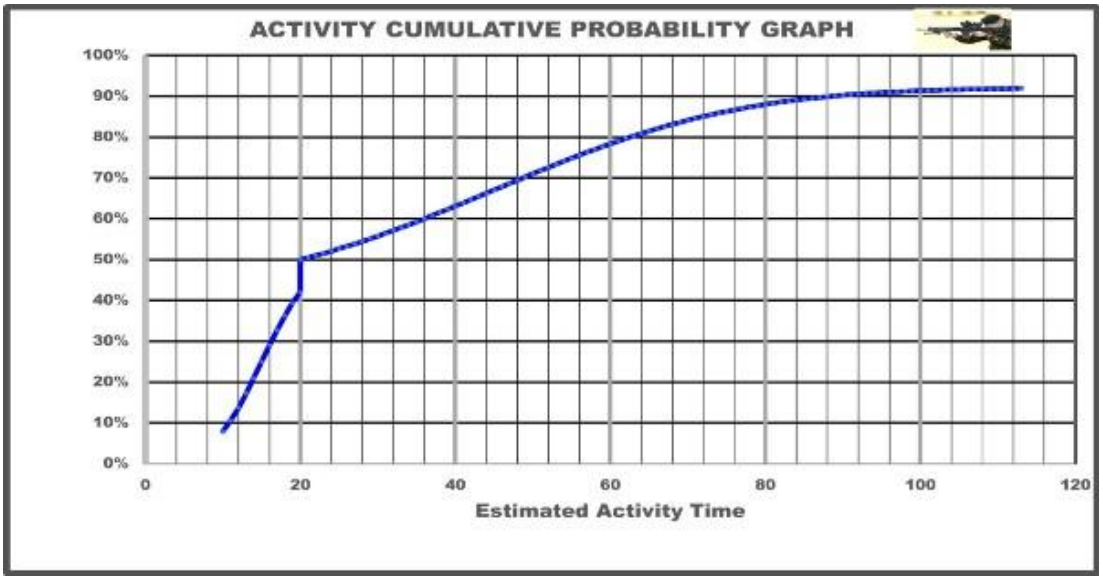
Continued on the following page . . . .

[11] Zach Bobbitt of Statology "How to Plot a CDF in Excel" Google Search

30	1.116	0.558	56%	
31	1.129	0.565	56%	
32	1.143	0.571	57%	
33	1.157	0.578	58%	
34	1.171	0.586	59%	
35	1.186	0.593	59%	
36	1.201	0.600	60%	
37	1.216	0.608	61%	
38	1.231	0.616	62%	
39	1.247	0.623	62%	
40	1.262	0.631	63%	
41	1.278	0.639	64%	
42	1.294	0.647	65%	
43	1.309	0.655	65%	
44	1.325	0.663	66%	
45	1.341	0.671	67%	
46	1.357	0.679	68%	
47	1.373	0.687	69%	
48	1.389	0.695	69%	
49	1.405	0.702	70%	
50	1.421	0.710	71%	
51	1.436	0.718	72%	
52	1.452	0.726	73%	
53	1.467	0.733	73%	
54	1.482	0.741	74%	
55	1.497	0.748	75%	
56	1.511	0.756	76%	
57	1.526	0.763	76%	
58	1.540	0.770	77%	
59	1.554	0.777	78%	
60	1.567	0.784	78%	
61	1.580	0.790	79%	
62	1.593	0.797	80%	
63	1.606	0.803	80%	
64	1.618	0.809	81%	
65	1.629	0.815	81%	
66	1.641	0.820	82%	
67	1.652	0.826	83%	
68	1.663	0.831	83%	
69	1.673	0.836	84%	
70	1.683	0.841	84%	T2 PESS: END OF T2 DATA
71	1.692	0.846	85%	DISCRETIONARY ADD ON TO RANGE
72	1.701	0.851	85%	
73	1.710	0.855	85%	
74	1.718	0.859	86%	
75	1.726	0.863	86%	
76	1.734	0.867	87%	

THE 'MURPHY EFFECT' IS WAY BEYOND THE ESTIMATED WORST CASE!

FIGURE 10



STEP 4b ***TRIAL & ERROR*** **PROBABILITY of a CDF TIME ESTIMATE with LOOKUP TABLE**

Enter Estimate: 40 **63% Probability**

STEP 5a **COMPARING WRIGHT WAY INVERSE TRIANGLE & SUBSEQUENT CDF PROBABILITIES FOR THE ENTIRE RANGE WITH SIMILAR VALUES IN NORMAL STDEV.P & PERT FORMULAS**

	-3 SD*	-2 SD*	-1 SD	Mean	+1 SD	+2 SD*	+3 SD*
NORMAL STDEV.P	-45	-19	7	33	60	86	112
Probability	*0%*	*2%*	*16%*	*50%*	*85%*	*98%*	*100%*
PROBABILITY COMPARED for the Same VALUES, although not their MEANS							
PERT	*0%*	*0%*	*0%*	*74%*	*100%*	*100%*	*100%*
WRIGHT WAY IT+CDF	*0%*	*0%*	*0%*	*58%*	*78%*	*90%*	*92%*

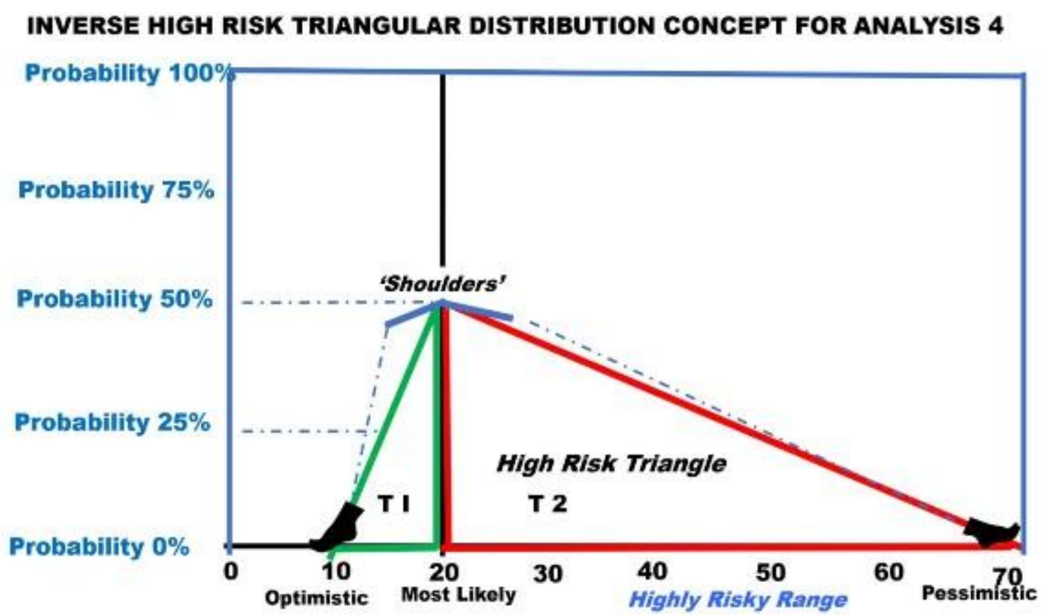
2. FINDINGS 1

1. **CDF** is an incremental ***Linear Step*** Function -- rather than a Bell-Shaped Curve NORMAL STDEV.P which locates Means in the middle of a Range. The Wright Way CDF therefore results in ***lower probability estimates*** than a NORMAL STDEV for Values after the Mean**.**

2. Furthermore, both triangle ranges in the Wright approach are skewed, but in opposite directions with a common Most Likely (Median & Mode) value. A CDF therefore ***negates the original intent*** to obtain separate solutions based on the different sizes of their skews**.**

3. While endorsing the triangular concept, utilizing a fixed cumulative step ignores the size of the differential skews in the two triangles; so I found it inappropriate. The objective is not to measure two differently-sized right-triangles with fixed laterals to determine their baseline value probabilities**. Rather, -- Conceptually the *two triangles should be reconfigured with their opposing 'shoulders' combined in a single lop-sided bell curve, and skew probabilities greater than their legs or their feet,*** as illustrated in Figure 11**.**

FIGURE 11



I proceeded accordingly, modifying both ranges adjacent to their common height, by weighting them as follows:

1. **Optimistic triangle**: Subtracting **1** from the Most Likely Value, and using it as a new Median Value.

2. **Pessimistic triangle**: Adding **1** to the Most Likely Value to create a Median Value.

New Optimistic Range				New Pessimistic Range		
Opt	ML - 1	Pess		Opt	ML + 1	Pess
10	19	20		20	21	70

Computing the triangles separately, each with 3 points, and their own Mean thus rectifies – *to some extent* -- the otherwise Probability distortion resulting from computing a single triangle for the entire range with a symmetrical normal standard deviation dispersion from its overall common Mean.

Nevertheless, both triangle lateral curves are still bell-shaped from their respective means.

NOTE: Utilizing the common 'Most Likely' value in each triangle, as well as a 'plus-up' and 'plus-down' effectively incurs the overall range being weighted by a factor of four – *i.e. the same weighting utilized by PERT!*

Results for selective Values, from Weighting each span separately, using a Normal STDEV.P formula – STEP 6 – are show in V, below.

STEP 6a

V1

KENCURVEOPT: MODIFIED 'OPT-WEIGHTED' RANGE

DR KEN's

Opt	ML - 1	ML
10	19	20
16	MEAN	
4.5	Standard Deviation	

V1

OPTIMISTIC — EXCEL Formula =STDEV.P($B$249:$E$249)

Single Shot

Standard Deviations from Mean

-3 SD	-2 SD	-1 SD	Mean	+1 SD	+2 SD	+3 SD
3	7	12	16	21	25	30

V2

KENCURVEPESS: MODIFIED 'PESS-WEIGHTED' RANGE

DR KEN's

ML	ML + 1	Pess
20	21	70
37	MEAN	
23.3	Standard Deviation	

V2

PESSIMISTIC — EXCEL Formula =STDEV.P($C$257:$E257)

Single Shot

Standard Deviations from Mean

-3 SD	-2 SD	-1 SD	Mean	+1 SD	+2 SD	+3 SD
-33	-10	14	37	60	84	107

STEP 6b

Combining the Probability results ***'at & below'*** the common Most Likely value in triangle T1 with the Probability results ***'at & above'*** the common Most Likely value in triangle T2 thus provided the desired lop-sided formation in a continuous distribution.

However, since the STDEV Probabilities for the two triangles are not equidistant from each other, each triangle's probabilities now had to be 'looked up' from a Standard Probability Table based on their respective "Z" scores, as indicated earlier.

For PROBABILITIES of Values in the Optimistic to Most Likely Range, use KENCURVEOPT

					-3 SD	-2 SD	-1 SD	Mean		Example
KENCURVEOPT										
	Opt	ML - 1	ML		3	7	12	16		Z SCORE for 15
V3	10	19	20	Use DATA VALUE 'Trial & Error' Table to obtain PROBABILITIES of VALUES in this Range						-1.200
	16	MEAN	20	*But First Shift the Curve SKEW left*, by substituting the ML for the Mean.						
	4.5	Standard Deviation		This Creates the Optimistic SD Curve's shape						

New Range =	10	11	12	13	14	15	16	17	18	19	20
Probability =	9%	13%	19%	25%	33%	41%	50%	59%	67%	75%	81%
Divide by 2 for T1 Cumulative Probability	5%	7%	10%	13%	17%	21%	25%	30%	34%	38%	41%

NOTE: Despite their different sizes, in this approach, each triangle comprises 50% of the overall Probabilistic Range. Therefore, for T1 the probability derived from the Z-scores was divided by **2**.

For Triangle 2, the value at the initial conjunction is now 50% cumulative probability, with the same value in the preceding Standard Deviation size utilized to generate the connective 'shoulder'.

NEXT: These OPT Probability Results *below the* Mean should then be combined with PESS Probability Results *above the* COMMON MEAN; for a CONTINUOUS PROBABILITY DISTRIBUTION to and from the INTEGRATED *MOST LIKELY VALUE*

For PROBABILITIES of Values in the Pessimistic to Most Likely Range, use KENCURVEPESS

Similarly:

KENCURVEPESS

	-3 SD	-2 SD	-1 SD	Mean	+1 SD
	-33	-10	14	37	60

ML	ML + 1	Pess
20	21	70

V4

MODIFY, THEN USE THE INSERT Table Above for PROBABILITIES of VALUES in this Range

37	MEAN
23.3	Standard Deviation

***But First Shift the Curve SKEW Right*, by substituting the ML for the Mean.**

This retains the Optimistic SD & Curve's shape, Re-Centered on the ML

New Range =	20	21	22	23	24	25	26	27	28	29	30
Probability =	50%	25%	26%	27%	29%	31%	32%	34%	35%	37%	38%
Divide by 2 for T2 Cumulative Probability		13%	13%	14%	15%	16%	16%	17%	18%	19%	19%
START AT 50%	50%	63%	63%	64%	65%	66%	66%	67%	68%	69%	69%

New Range =	31	32	33	34	35	36	37	38	39	40	41
Probability =	40%	42%	43%	45%	47%	48%	50%	52%	53%	55%	57%
Divide by 2 for T2 Cumulative Probability		21%	22%	23%	24%	24%	25%	26%	27%	28%	29%
START AT 50%	50%	71%	72%	73%	74%	74%	75%	76%	77%	78%	79%

New Range =	42	43	44	45	46	47	48	49	50	51	52
Probability =	58%	60%	62%	63%	65%	66%	68%	69%	71%	73%	74%
Divide by 2 for T2 Cumulative Probability		30%	31%	32%	33%	33%	34%	35%	36%	37%	37%
START AT 50%	50%	80%	81%	82%	83%	83%	84%	85%	86%	87%	87%

New Range =	53	54	55	56	57	58	59	60	61	62	63
Probability =	75%	76%	78%	79%	80%	82%	83%	84%	85%	86%	87%
Divide by 2 for T2 Cumulative Probability		38%	39%	40%	40%	41%	42%	42%	43%	43%	44%
START AT 50%	50%	88%	89%	90%	90%	91%	92%	92%	93%	93%	94%

New Range =	64	65	66	67	68	69	70	71	72	73	74
Probability =	87%	88%	89%	90%	91%	91%	92%	93%	93%	94%	94%
Divide by 2 for T2 Cumulative Probability		44%	45%	45%	46%	46%	46%	47%	47%	47%	47%
START AT 50%	50%	94%	95%	95%	96%	96%	96%	97%	97%	97%	97%

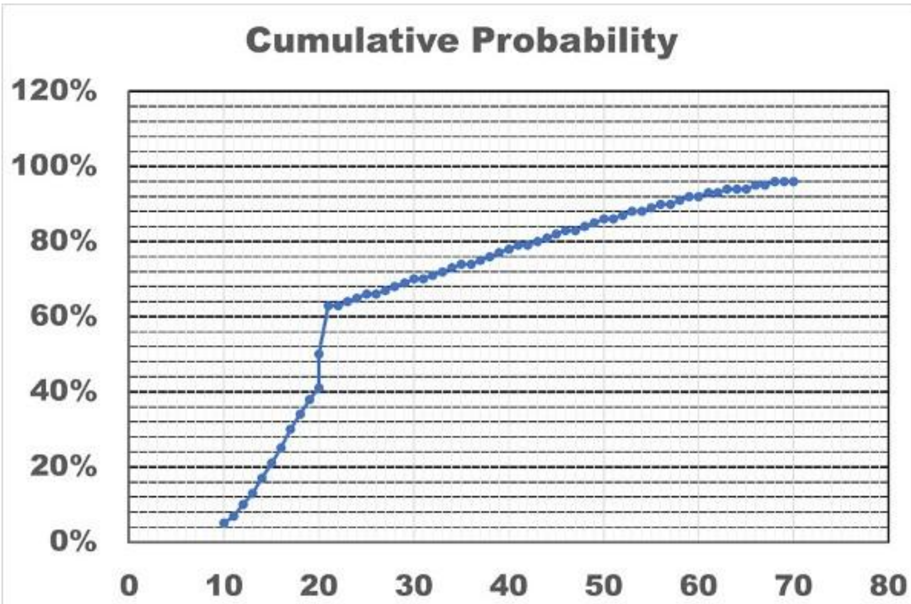
MEANINGLESS BEYOND THIS VALUE

STEP 6c Combine the Results from both Opt & Pess triangles to compute CUMULATIVE PROBABILITIES for every Interval Value in the Overall Range.

KEN-CUMULATIVE DATA TABLE COMBINING T1 & T2
LOW TO HIGH **FOR A SINGLE SHOT**

		DATA	Cum PROB	
OPT		10	5%	
		11	7%	
		12	10%	
		13	13%	
		14	17%	
		15	21%	
		16	25%	
		17	30%	
		18	34%	
	ROW	19	38%	
OPT	345	20	41%	
PESS	346	20	50%	START T2 DATA: at ROW E346
		21	63%	SHOULDER EFFECT
		22	63%	
		23	64%	
		24	65%	
		25	66%	
		26	66%	
		27	67%	
		28	68%	
		29	69%	
		30	70%	
		31	70%	
		32	71%	
		33	72%	
		34	73%	
		35	74%	
		36	74%	
		37	75%	
		38	76%	
		39	77%	
		40	78%	
		41	79%	
		42	79%	
		43	80%	
		44	81%	
		45	82%	
		46	83%	
		47	83%	
		48	84%	
		49	85%	
		50	86%	
		51	86%	
		52	87%	
		53	88%	
		54	88%	
		55	89%	
		56	90%	
		57	90%	
		58	91%	
		59	92%	
		60	92%	
		61	93%	
		62	93%	
		63	94%	
		64	94%	
		65	94%	
		66	95%	
		67	95%	
		68	96%	
		69	96%	
		70	96%	MEANINGLESS BEYOND THIS VALUE

FIGURE 12
'SHOULDER EFFECT'



COMPARING KENCURVE STDDEV WEIGHTED PROBABILITIES WITH THE PROBABILITIES OF SIMILAR VALUES IN NORMAL STDEV.P, PERT & WRIGHT FORMULAS

Opt	ML	Pess		-3 SD*	-2 SD*	-1 SD	Mean	+1 SD	+2 SD*	+3 SD*
10	20	70	NORMAL STDEV.P	-45	-19	7	33	60	86	112
Mean		33	*Probability*	0%	2%	16%	50%	85%	98%	100%
St. Dev		26	PROBABILITY COMPARED FOR SAME NORMAL STDEV.P VALUES though NOT the Mean & SDs				33	60	86	112
SYMMETRICAL CURVE			PERT	NA	NA	0%	74%	100%	100%	100%
LINEAR			WRIGHT WAY IT+CDF	NA	NA	0%	58%	78%	90%	92%
RIGHT-SKEW CURVE			KENCURVE Pess	NA	NA	0%	72%	92%	100%	100%

SIGNIFICANCE TEST FOR A PERCENTAGE

TO ASSESS THE SIGNIFICANT DIFFERENCE BETWEEN TWO SETS OF DATA

© Dr. Kenneth F. Smith, PMP February 2000 Lotus123; Excel September 2005, May 2009, & October 2021

ENTER REPORTED CENSUS (or Baseline Sample) & Comparative SAMPLE RESULTS in YELLOW Cells Below

REPORTED BASELINE Census or SAMPLE # 1		*COMPARATIVE SAMPLE # 2*		
PERCENT RESULT =	74 %	PERCENT RESULT =	72 %	
CENSUS (or Sample#1) Size (N or n)	4	Sample # 2 Size (n)	4	
Standard Error % (SEP)	21.93 %	Std Error % (SEP)	22.45 %	
Confidence Level Estimated:	99 %	Confidence Level Desired:	99 %	for evaluation
[Normally, From 95% to 99% is Acceptable]		that both the Sample and Census are from the same Population		
		NOTE: Higher Confidence Levels produce larger Margins of Error		
With Margin of Error = +/-	56.36 %	*With Margin of Error = +/-*	57.70 %	which may not
Lower Limit of :	17.6 %	*Lower Limit of :*	14.3 %	be acceptable
& Upper Limit of :	130.4 %	*& Upper Limit of :*	129.7 %	to the survey
# Standard Deviations =	2.57	# Standard Deviations =	2.57	sponsor's
		i.e. Favorable Odds of	100 :1	management

CONCLUSION: ***A STATISTICAL TIE - Ranges Overlap***

NO SIGNIFICANT DIFFERENCE BETWEEN THE TWO SETS OF DATA

3. FINDINGS 2

1. Due to the large Standard Deviation, there was no significant difference between the approaches. However, Dr. Wright's Linear CDF deflates Probabilities; extending completion probability beyond the Worst Case; which, *from experience*, is not unrealistic.

2. Similarly, the difference between a KENCURVE and PERT was not significant – given this assumed distribution -- although in this case, weighting PERT's Most Likely Value by 4 was insufficient to offset the Higher Probabilities for its Outlier Values generated by its Normal Bell Curve**.**

3. In retrospect, PERT four-fold weighting was not as arbitrary as previously perceived. Nevertheless, that did not invalidate PERT's Weighting procedure. [*In fact, my Inverse Triangular variant approach* ***also*** *weighted the Most Likely value four-fold*.]

4. PERT's process merely shifts an overall symmetrical bell curve's Mean closer to the Most Likely Value, and truncates results beyond the user-estimated range; an absolute roadblock.

5. Nevertheless, the absolute Variance between the Normal Curve, PERT and the Inverse Triangular Linear Cumulative Step methods is sufficiently large as to give concern for Planning & Scheduling.

6. Although still imperfect, my weighted variation of the two adjacent triangles -- *now in a Continuous Normal Distribution* -- approximates a lop-sided curve more realistically than PERT's weighted symmetrical curve, constricted range and estimated standard deviation formulation; or the two unweighted Inverse Triangles in a linear step CDF.

[**NOTE:** Standard deviation alone doesn't determine probabilities ***in the tails*** – distribution family matters a lot (i.e. normal *vs* triangular *vs* lognormal can behave very differently)]

D. CONCLUSIONS

1. In the past PERT served me – *and millions of others* – well. However, from this review, I concur with Dr. Paul Giammalvo that **PERT is now Passe.**

2. However, at this stage of my review, the Inverse Triangular approach satisfies Paul's second-strike suggestion as a **new Excel-*based* formulation incorporating skewness and a more realistic probability profile.**

3. **IMO,** a Linear Continuous Distribution Function (CDF) approach is not useful for estimating the duration of single Activities in skewed scenarios where the Risks are already known, and the options have been weighed.

4. Nevertheless**,** a Linear Continuous Distribution Function (CDF) appears eminently reasonable to assess activity durations of *unknown data risks* and their related Probabilities.

E. RECOMMENDATION

I recommend the **modified Inverse Triangular approach** *weighting both the Optimistic and Pessimistic Ranges; then combining their respective cumulative before & after 50% probabilities for a* ***continuous curve distribution*** -- be adopted for deterministic estimating. [I suggest designating it **ADEPT** –**A**ctivity **D**uration **E**stimating with **P**robability **T**riangulation]

PART 2 A
MONTE CARLO FOR ESTIMATING SINGLE ACTIVITY DURATIONS & PROBABILITIES

Having reviewed and resolved the PERT issue – *somewhat to my chagrin, but relieved I had found a better method* -- I now moved on to explore the Monte Carlo approach as yet a still better alternative for estimating activity durations and their respective probabilities, for planning purposes. The essence of Monte Carlo – *as I understood it at that juncture* – was duration ranges with related probability estimates were arrived at from numerous random iterations of the activity data-set input; as opposed to the traditional approach of a deterministic Mean or Most Likely result computed from a single shot, or alternatives from a standard deviation lookup table.

.

Since Dr. Wright and Sanzio Castor said the Inverse Triangular (IT) approach was for a Monte Carlo application, although I had already stumbled upon and modified IT to determine an activity's duration & probability with Excel, I continued to examine its utility in the MC mode.

While Dr. Wright's example employed five thousand iterations, and Sanzio Castor's process was open-ended, instead, I constructed an Excel Template – described on the following pages -- to compare the difference -- if any -- from generating ten thousand iterations *vs* results from a single shot; as well as the potential benefit from the extra effort.

I created Two Tables -- *10 Columns by 1,000 Rows* -- to accommodate the 10,000 Random Values generated by the Excel Formula =NORM.INV(RAND(),Mean,Std Dev) of the data for each of the Triangles -- T1 & T2.

Table 1 is located in Range B527 to L1526

Table 2 is located in Range B1527 to L2526

3. The Values from these tables are then inserted in a Cumulative Distribution Table

Located at M855 through Q1155, commencing with the Minimum Value

KEN'S 10K MONTE CARLO LOOKUP TABLE
Template then uses this data to create Tw

RANGE	**$B$527:$L$2526**			
Min Value	**-49**			
Max Value	**123**			
LIKELY - 1 **Count Iterations**	**20,000**	**10K Opt & 10K Pess**		
LIKELY				
Bin Width	1			
CUMULATIVE PERCENTAGE COUNTER				
VALUE	**LL to UL**	**Frequency**	**CUM FREQ**	**CUM %**
-49	-49	0	0	**0%**

4. The User can then Review the Table directly, or Request a Specific Value & Probability by 'Trial & Error' via the Lookup function.

TRIAL & ERROR: KEN's 10K MONTE CARLO *@ 10,000 Iterations per hit*

What Value would you like to use for this Activity?

INVERSE TRIANGLE 10,000 iterations

Y

ENTER

Your Choice

31

Probability =	**70%**

W1

KENS OPT-WEIGHTED MONTE CARLO SIMULATION 10K

OPTIMISTIC =NORM.INV(RAND(),b489,$b490)

DR KEN 1 shot

W1	Opt	ML - 1	ML
	10	19	20

16.3	MEAN
4.5	Standard Deviation

ALMOST THE SAME MEAN & STANDARD DEVIATION

10,000 iteration results

16.4	MEAN	of the 1st 10K table
4.5	Standard Deviation	

Standard Deviations from Mean

-3 SD	-2 SD	-1 SD	Mean	+1 SD	+2 SD	+3 SD
3	7	12	16	21	25	30

W2

KEN's PESS-WEIGHTED MONTE CARLO SIMULATION 10K

PESSIMISTIC =NORM.INV(RAND(),$B$502,$B$503)

DR KEN 1 shot

W2	ML	ML + 1	ML + 2	Pess
	20	21		70

37.0	MEAN
23.3	Standard Deviation

ALMOST THE SAME MEAN & STANDARD DEVIATION

10,000 iteration results

37.4	MEAN	of the 2nd 10K table
23.3	Standard Deviation	

Standard Deviations from Mean

-3 SD	-2 SD	-1 SD	Mean	+1 SD	+2 SD	+3 SD
-33	-9	14	37	61	84	107

FINDING

Although a large standard deviation for a small sample may not be statistically significant while a small SD may be significant for a large one, I saw no meaningful difference between results from a single shot and 10 thousand iterations for determining activity durations and related probabilities of either the Optimistic or Pessimistic ranges in W1 & W2 above.

However, after re-reading Dr. Wright's article, ***I belatedly realized I was on a wild goose chase!*** Although **the triangular concept** propounded was pertinent to my Activity-estimating analogy to a point – ***indeed the keystone for a new paradigm to succeed PERT*** – Dr. Wright's Monte Carlo was for a more complex purpose beyond simply determining probability. Her MC example facilitated a ***'Make or Buy'*** decision, dependent on which triangle additional costs were most likely to occur, given prior criteria incorporated in the model.

CONCLUSION

My comparison of Monte Carlo *vs* single shot was <u>Not Relevant</u>! So, while appreciative of the exercise & triangulation lessons learned; faced with the ***'Dog's Dilemma'***[12] **I had to let it go!**

Emulating Edison: *"I just found 10,000 ways that won't work!"*

[12] i.e. What does a dog intend to do after catching up with the bus he was chasing?

PART 2 B
MONTE CARLO SIMULATION FOR PROJECT MANAGEMENT

While having been vaguely aware of the statistical Monte Carlo simulation system for many years, as well as the eponymous district in Monaco, world-famous for its casino -- *but neglecting both* -- I finally waded into Monte Carlo's technique pool to become better acquainted with its features, promises, and prospects for future application. First, I learned -- to my surprise -- that unlike Normal Standard Deviation and PERT formulas with which I was long acquainted, Monte Carlo is not just a single tool & technique, but rather the generic name for a variety of tools to analyze datasets for risks from different sectors, through random number reiterations.

During Part 2A, I learned that random iterations may not provide much – *if any* – benefit over a single shot to show an activity's duration possibilities with related probabilities. But Projects are much more than a single activity. They are comprised of multiple activities for different components, and although their diverse activities are mostly sequential many are concurrent and interrelated. So, while I didn't see the value of Monte Carlo for a single 3-point activity estimate I appreciated how MC could be invaluable to plan & schedule an entire project composed of multiple interacting activities; *a prospect beyond my wildest dreams when I was actively involved!*

The **Critical Path Method (CPM)** was developed to address the 'Big Picture' with its 'merge' and 'burst' Milestones, and a 'critical' path for scheduling acceptable dates with float and key deliverable deadlines – that we used to joke was a '**P**oor **E**xcuse for the **R**eal **T**hing!'. But unlike a real 'roadmap', a planned CPM network was only a partial solution. After planning, activities were not static, ***nor was the critical path even constant***, but the probabilistic aspects were frequently forgotten. Activity durations varied from the original plan during implementation; impacting other downstream activities, both sequentially and concurrently – *somewhat like items in a kaleidoscope* -- with endless possibilities. So, I was eagerly anticipating what MC could offer.

Several SMEs soon enlightened me that 20th Century's *one-on-one* deterministic duration estimating for planning was 'old school'. Time estimating could not be isolated from Cost, Quality, Risk & Opportunity. Nowadays the 'Go-to' approach is collaboration, with interested parties meeting to consider a variety of risks; and a planning facilitator -- *armed with Monte Carlo software* -- entering options and displaying outcomes. Depicting "***What if's***", Monte Carlo simulation shows different managers how varying options could affect the schedule, budget & other aspects; so everyone could better appreciate the impact of any decision on the overall project.

For awareness of the interactive complexity, a simple example with two activities – ***a coin toss and a 6-sided die*** -- illustrates the probability computation process;

A coin toss has 1 of 2 possible outcomes = 50% Probability
And the roll of a die has 1 of 6 possible outcomes 1 of 6 = 16.67%

But for <u>both</u> occurring *at the same time* <u>12 combinations</u> are possible: i.e. 2 x 6 = 12
So the probability of each of those 12 combinations occurring is reduced to only 8.3%

The computation process for multiple activities and determining the next steps is mind-boggling! Moreover, Monte Carlo is also useful beyond planning, for assessing "***What is***" during the dynamic implementation phase, and "***What could be next***". While many Project Activities are independent, some are Mergers – *which can become bottlenecks.* Paraphrasing AI:

> Monte Carlo simulations come to the fore dealing with high uncertainty, and systems with multiple random variables where traditional static modeling fails. Its iterative technique runs thousands of simulations, using random sampling to map out a wide range of possible outcomes and their probabilities -- ***often revealing that the original "most likely" critical path scenario is <u>not the most probable</u>*** – thereby enabling decision-makers to visualize and make adjustments for risk rather than simply relying on a single "best guess" estimate.

For application, again a synopsis from AI:

> **Monte Carlo Simulation (MCS)** is typically categorized into four main structural types, or alternately grouped by their approach to time and sampling.
>
> **1. Structural Classification**
> Based on complexity and how the "stages" of the simulation interact:
> 1) **Single-stage MCS:** A basic model where inputs lead directly to an outcome in one step
>   (e.g., a simple coin toss or profit-risk analysis).
> 2) **Multiple-stage MCS:** Expansion of the single-stage model, where the simulation progresses through a series of sequential events.
> 3) **Mixture MCS:** A nonlinear system where the probability is based on a subpopulation of other probabilities (e.g., using "mixture distributions").
> 4) **Markov Chain Monte Carlo (MCMC):** The most sophisticated system, where the current state of the simulation depends directly on the previous state in a recursive chain.
>
> **2. Temporal Classification**
> Systems are also categorized by how they handle the passage of time:
> 1) **Non-Sequential (Static) MCS:** Simulates states randomly without considering a time axis. Used for modeling probabilistic events where characteristics don't vary over time.
> 2) **Sequential (Chronological) MCS:** Performs simulations in chronological order. For systems where time series and history matter, such as stability analysis.
>
> **3. Specialized Sampling Systems**
> Different "systems" based on how they pick random numbers to improve speed or accuracy:
> 1) **Standard Random Sampling:** The traditional method using pseudorandom numbers.
> 2) **Quasi-Monte Carlo:** Uses low-discrepancy (more evenly distributed) sequences to improve efficiency.
> 3) **Latin Hypercube Sampling (LHS):** A specialized system that ensures all parts of a distribution range are sampled, reducing the number of trials needed.
> 4) **Importance Sampling:** Focuses on rare events that have a high impact on the result.

> **Bottom Line Consideration:** The MCS process is objective, but inputs are subjective. You have to make subjective assumptions to define the MCS input model. From this perspective, you can't have a 100% objective model, only a relatively objective one.
> **NOTE:** Please follow the cautionary advice by Mona -- *Mighty Magulang* -- Magno-Veluz[13] that "*treating AI outputs as authoritative sources is a mistake*" and to "*cross-check with credible sources before believing or amplifying it*".

To summarize; the mathematics underlying Monte Carlo's simulation methodologies are complex; but software tools can handle the complexities of computing many moving parts far beyond the capabilities of simple equations; which enables analysts and decision-makers to use these powerful techniques for more effective program and project management.

During my review the following specialized MC software packages – *listed alphabetically* -- were referred to me by experts in the business, and I share them with you for your consideration.

Acumen Fuse
Analytica — by Lumina
ChanceCalc+
Crystal Ball -- from Oracle
Deltek
GoldSim
ModelRisk
Palisade @RISK
Primavera Risk Analysis
RiskyProject by Intaver Institute Inc. (www.intaver.com) **sales@intaver.com**
Safran (cloud-based)
Simul8
Solver add-in from Frontline Systems
SPERT William W. Davis, MSPM, PMP
famousdavispmp@131710194.mailchimpapp.com
Spider Project

And trust some of my findings may also be of use to you.

In conclusion, after floundering in the Monte Carlo pool I cannot claim to have acquired any competence with MC beyond my Excel bubble. However, I now have a greater awareness of the capabilities that computers provide to handle the complexities of assessing options for project planning and management; as well as now having a better tool -- *beyond my long-time 95% 'PERT-Plus 2 SDs* -- to explain activity estimating concepts to project management beginners and practitioners. So, having slightly upgraded my obsolescence, hat in hand with this reactive review

I'll homeward plod my weary way,
and leave the world to MC; and to thee.

[13] National spokesperson of the Autism Society Philippines "Digital Media literacy matters", Philippine Star Feb 7 2026

POSTSCRIPT:
I am deeply appreciative of the impetus *and continuing support* provided by Dr. Paul Giammalvo -- *who jolted me in the first instance from my semi-retired project management comfort cocoon* -- to take stock of what I thought I knew; the enlightening guidance articles by Dr. Wright, Sanzio Castor and Zach Bobbitt– *complete with lucid rationale, graphics, formulas, step-by-step instructions and application templates* -- as well as the substantive technical contributions provided by John Driessnack, Dr. David T. Hulett & Michael Trumper; additional comments by Bryan Tapnio, Patrick Ferrer, and especially Angelo Katigbak who spent a couple of hours with me explaining & demonstrating how he utilizes Monte Carlo on-the-job for planning and risk assessment. Thank you Paul *et al* for the feedback, extracting me from the quagmire into which I ventured.

About the Author

Dr. Kenneth Smith

Honolulu, Hawaii
& Manila, The Philippines

Initially a US Civil Service Management Intern, then a management analyst & systems specialist with the US Defense Department, Ken subsequently had a career as a senior foreign service officer -- management & evaluation specialist, project manager, and in-house facilitator/trainer -- with the US Agency for International Development (USAID). Ken assisted host country governments in many countries to plan, monitor and evaluate projects in various technical sectors; working 'hands-on' with their officers as well as other USAID personnel, contractors and NGOs. Intermittently, he was also a team leader &/or team member to conduct project, program & and country-level portfolio analyses and evaluations.

Concurrently, Ken had an active dual career as Air Force ready-reservist in Asia (Japan, Korea, Vietnam, Indonesia, Philippines) as well as the Washington D.C. area; was Chairman of a

Congressional Services Academy Advisory Board (SAAB); and had additional duties as an Air Force Academy Liaison Officer. He retired as a 'bird' colonel.

After retirement from USAID, Ken was a project management consultant for ADB, the World Bank, UNDP and USAID.

He earned his DPA (Doctor of Public Administration) from the George Mason University (GMU) in Virginia, his MS from Massachusetts Institute of Technology (MIT Systems Analysis Fellow, Center for Advanced Engineering Study), and BA & MA degrees in Government & International Relations from the University of Connecticut (UCONN). A long-time member of the Project Management Institute (PMI) and IPMA-USA, Ken is a Certified Project Management Professional (PMP®) and a member of the PMI®-Honolulu and Philippines Chapters.

Ken has two KENBOOKS: 1. Project Management PRAXIS which includes many innovative project management tools & techniques; and describes a "Toolkit" of related templates, and 2. MUSINGS on Project Management -- a compilation of contemporary concerns in project planning, monitoring & evaluation, with some tools & techniques suggested for their solution. Either or both books are available from Amazon, and their related templates are available directly from him at kenfsmith@aol.com on proof of purchase.

To view other works by Ken Smith, visit his author showcase in the PM World Library at https://pmworldlibrary.net/authors/dr-kenneth-smith/