Project Planning & Control

Lesson 3
Uncertainty in Project Schedules

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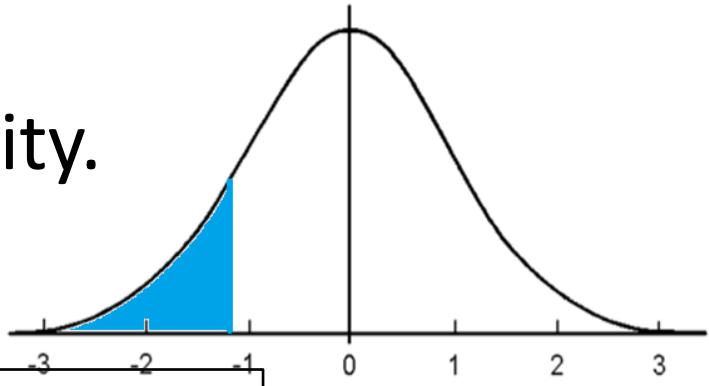
Lecture Outline

- Uncertainty in Project Schedules
- PERT Background & Assumptions
- PERT – Stepwise Procedure
- PERT Examples
- Summary

Prerequisite Knowledge

- You should be familiar with reading standard normal distribution (given μ & σ) to:
- (i) Find probability (area under the curve) for a given value (x).
- (ii) Find value given a probability.



https://www.youtube.com/watch?v=_86q-hn_3DQ
http://nptel.ac.in/courses/105103027/1
https://www.youtube.com/watch?v=mai23vW8uFM

Uncertainty in Projects

- CPM does not directly model uncertainty- No probability based query can be modeled in CPM.

- Uncertainty is an inherent characteristic of all projects.
  - Duration uncertainty, Cost uncertainty, Quality uncertainty, Resource uncertainty, etc……

- Construction projects have a relatively lower level of uncertainty compared to research/defense/space projects.

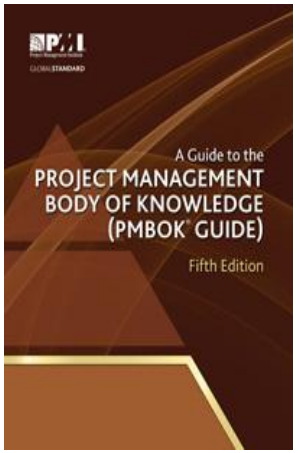
Uncertainty in Projects

- Uncertainty in construction can be addressed through risk analysis and management

- Modeling & managing duration uncertainty & risk is an important part of project planning and control

- PERT was developed to address the needs of projects which are being done for the first time – *challenge to estimate activity duration.*

Activity Duration Estimating



6.4.2 Tools & Techniques

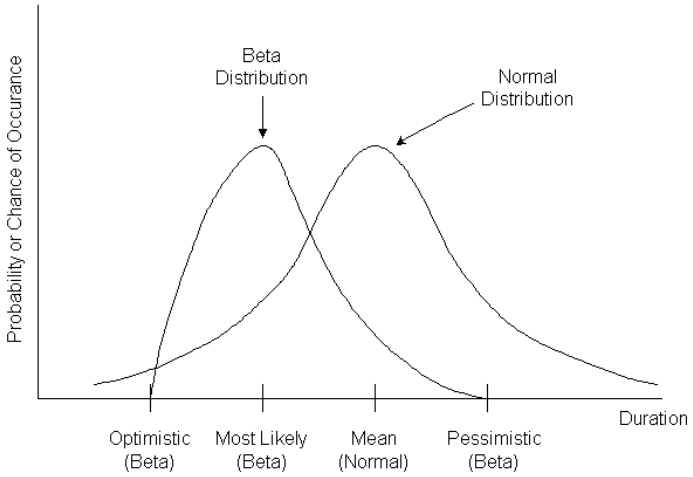
- **Expert Judgment (Heuristic)**
- Analogous Estimating (Data + Heuristic)
- Parametric estimating
- **Three Point Estimate (Uncertainty)**
- Reserve analysis (Buffer)

Probabilistic Duration

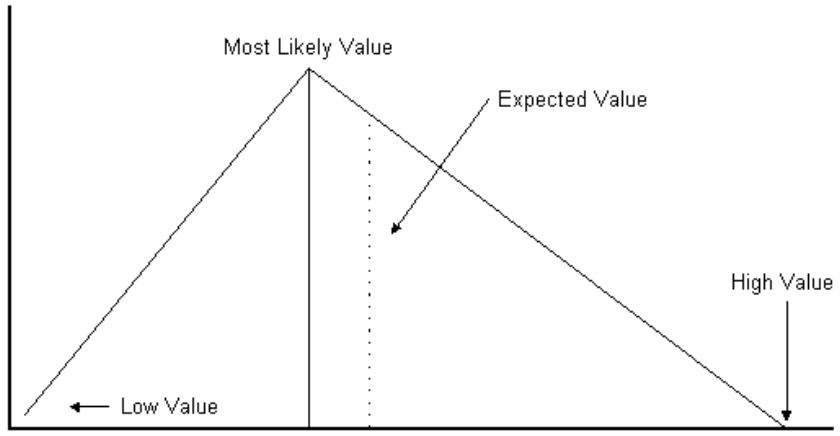
- Probabilistic duration distribution is used to account for the uncertainty in activity duration estimation.

- The duration of a particular activity is assumed to be a stochastic variable that follows a certain distribution as shown in the figure below

Historical Data



Expert Opinion



Probabilistic Duration

(Historical Data)

- Consider duration data which was collected for a activity.

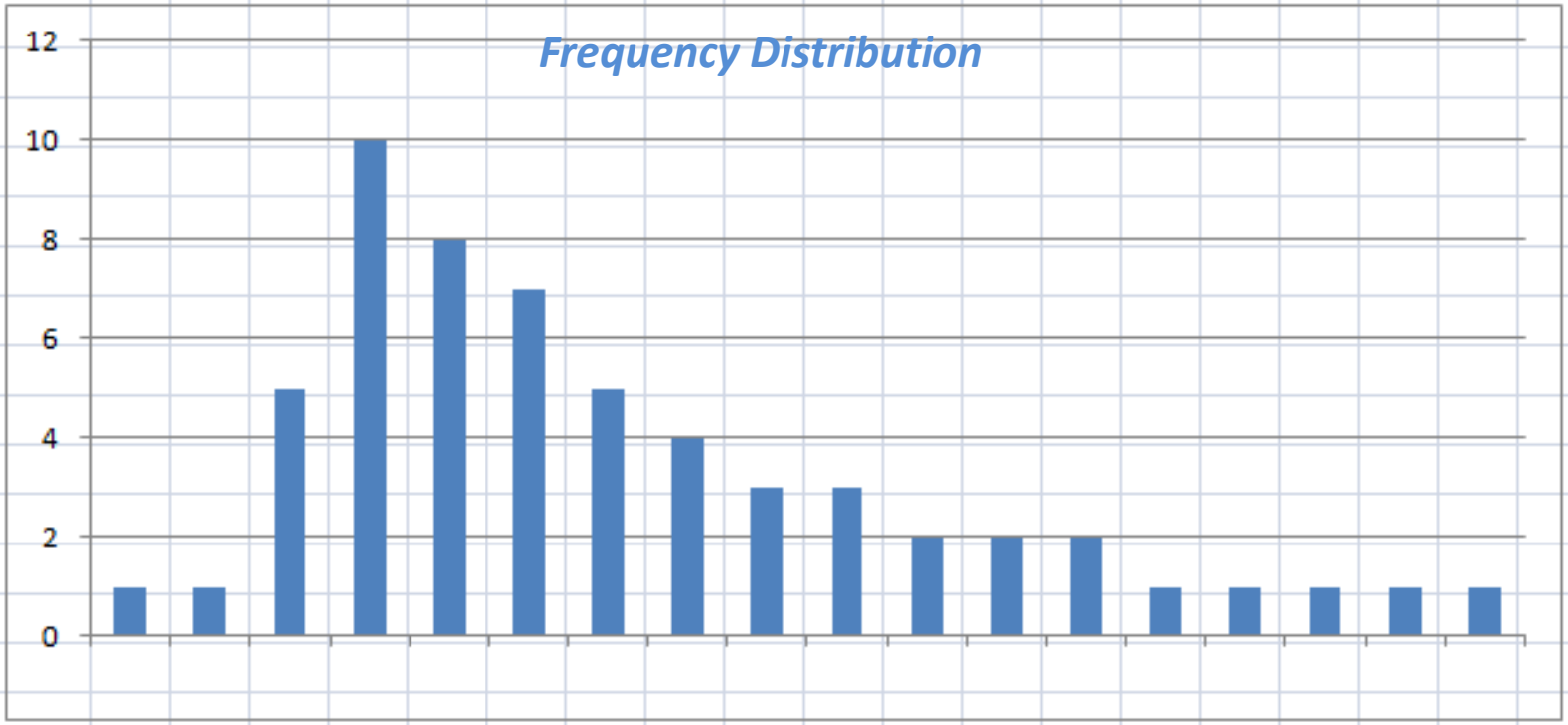
Duration (days)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Occurances	1	1	5	10	8	7	5	4	3	3	2	2	2	1	1	1	1	1

Mean = 8.17 days
Mode = 5 days
Median = 7 days

Probabilistic Duration

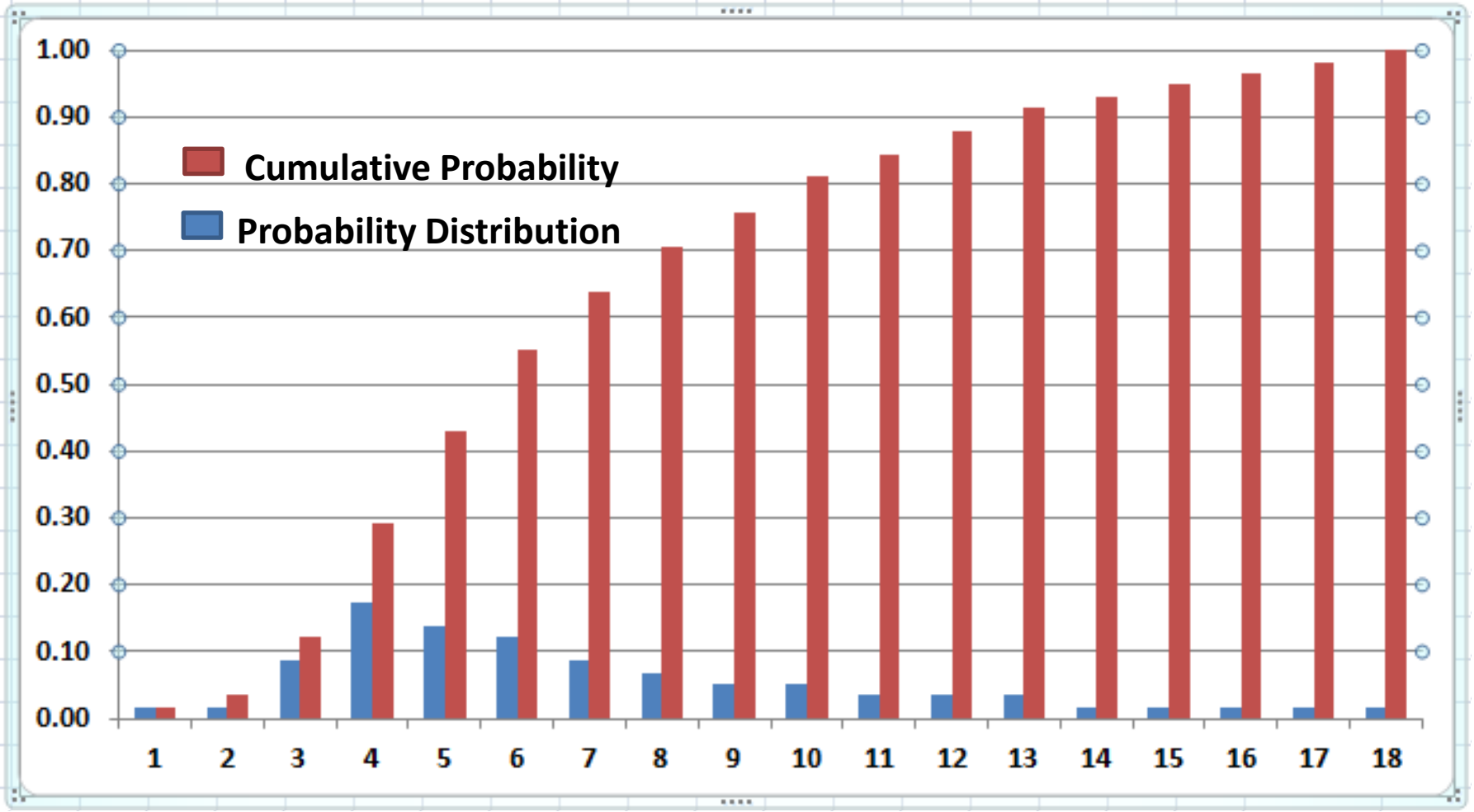
(Historical Data)

Duration	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Occurances	1	1	5	10	8	7	5	4	3	3	2	2	2	1	1	1	1	1



Probabilistic Duration

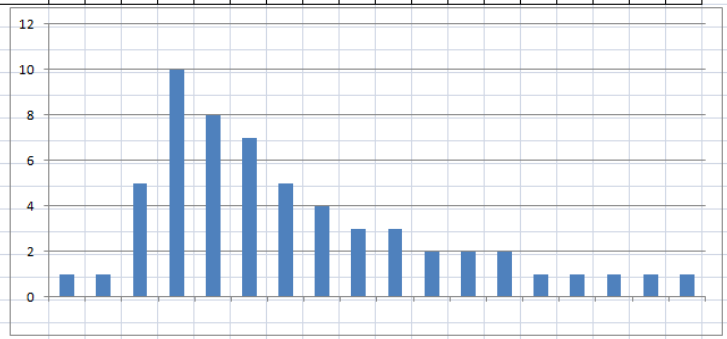
(Historical Data)

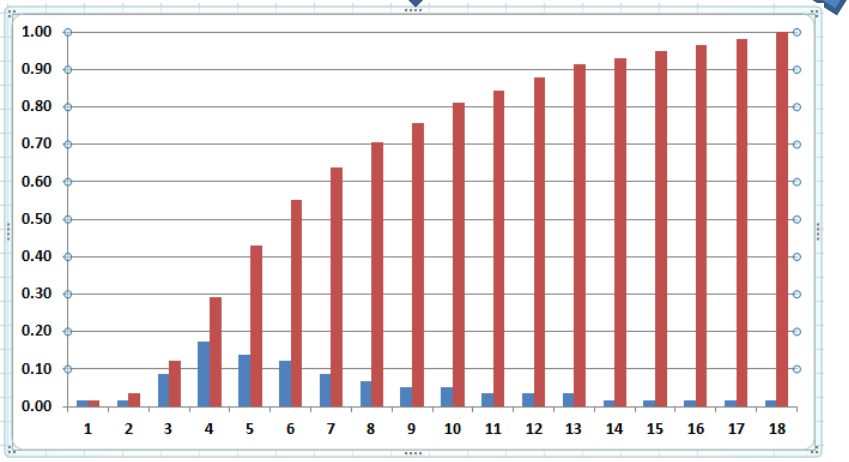


Probabilistic Duration (**Historical Data**)

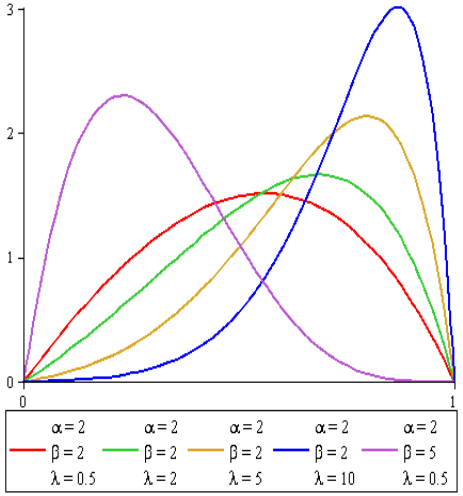
Distribution Fitting

Duration	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Occurances	1	1	5	10	8	7	5	4	3	3	2	2	2	1	1	1	1	1





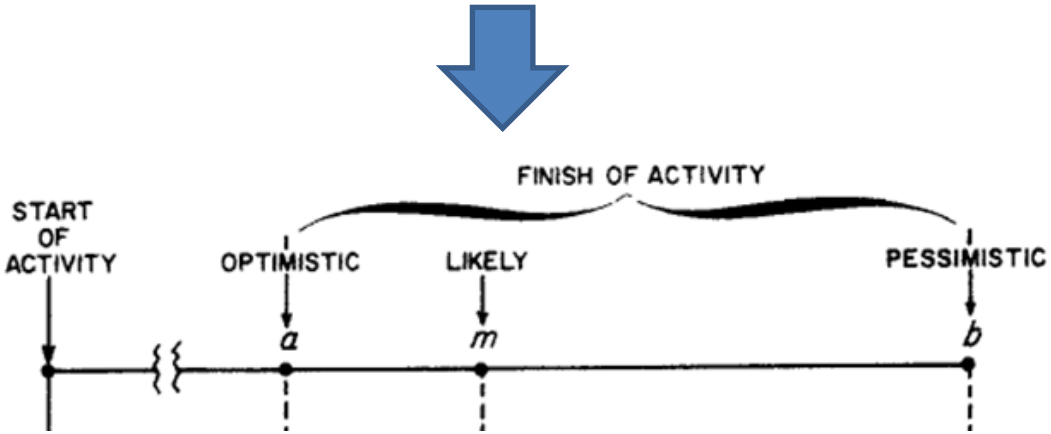
- Beta
- Binomial
- Cauchy
- Chi Squared
- Constant
- Empirical discrete
- Empirical stepped
- Empirical interpolated
- Erlang
- Exponential
- Extreme Value Type 1A
- Extreme Value Type 1B
- Gamma
- Geometric
- HyperExponential
- Hypergeometric
- Inverse Gaussian
- Inverse Weibull
- Johnson SB
- Johnson SU
- Laplace
- Logarithmic
- Logistic
- Log-Logistic
- Lognormal
- Negative Binomial
- Normal
- Pareto
- Pearson type V
- Pearson type VI
- Poisson
- Power Function
- Rayleigh
- Triangular
- Uniform, Integer
- Uniform, Real

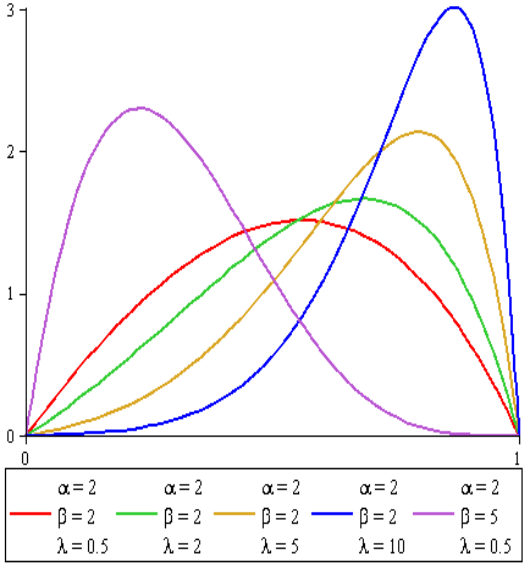


Beta Type Distribution Is found to be best for Const. Duration

Probabilistic Duration
(Expert Estimate)

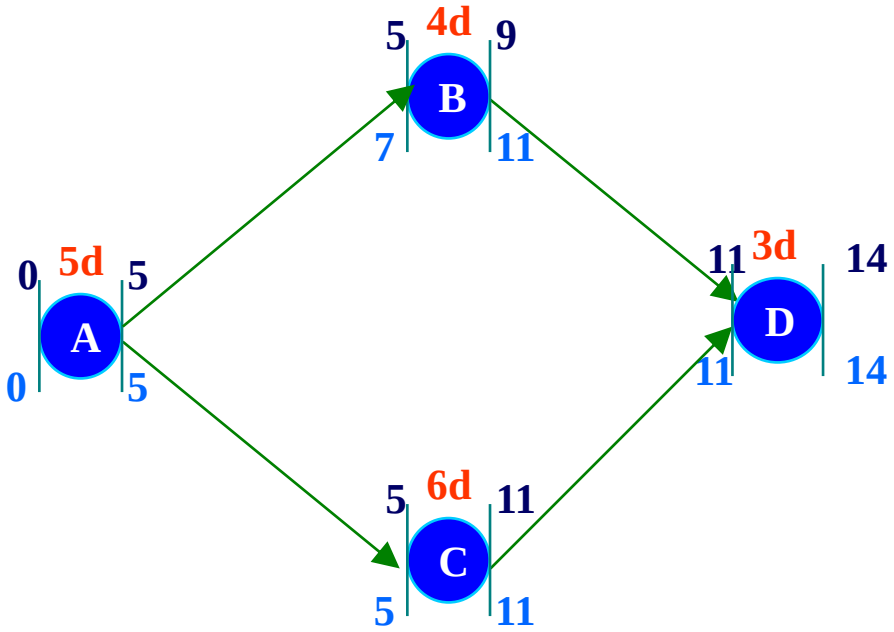
Expert – 3 time estimates





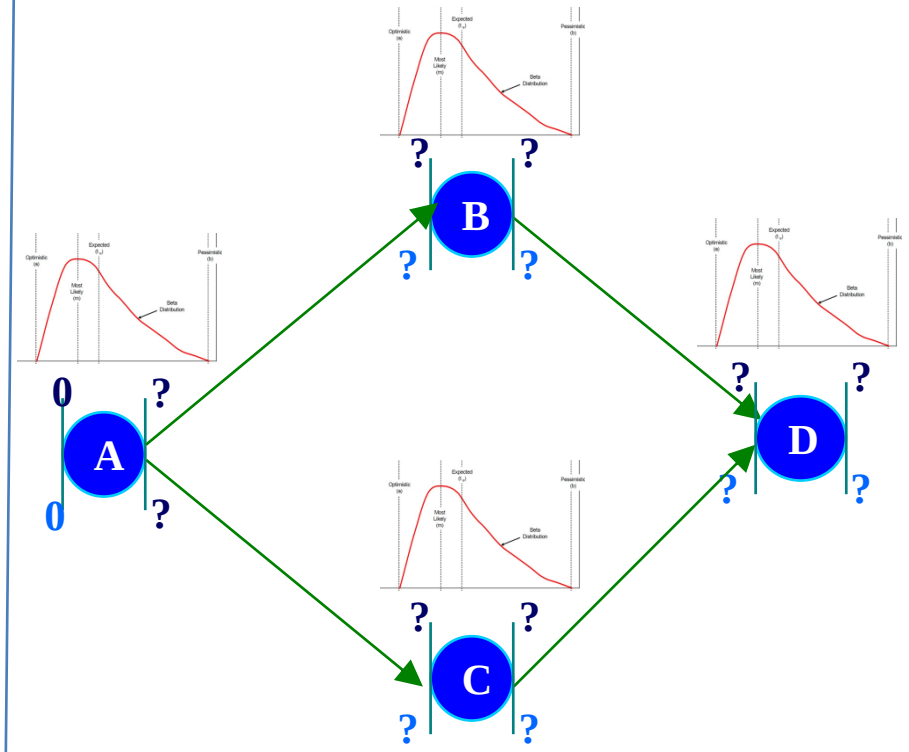
Beta Type Distribution

Deterministic Duration
(Historical data or Computations)



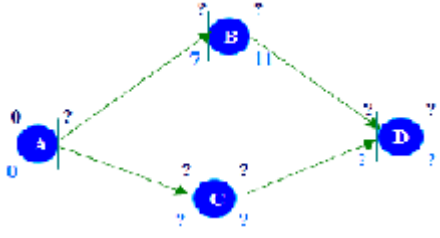
CPM

Probabilistic Duration
(Historical or Expert Data)

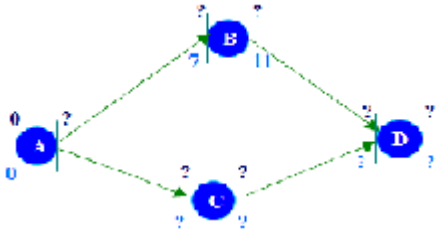


SIMULATION
OR
PERT

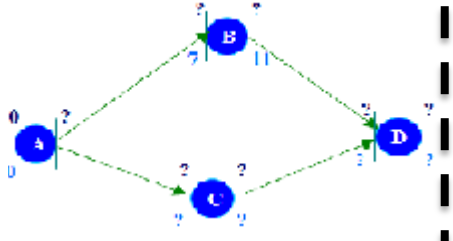
SIMULATION



Run-1



Run-5



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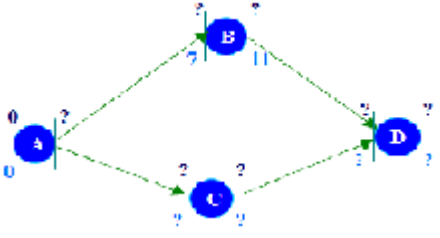
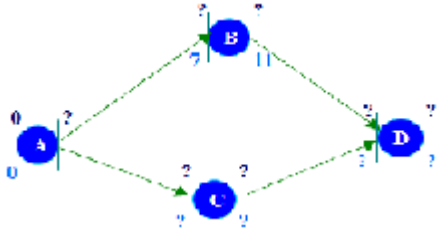
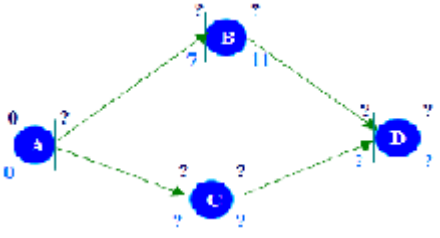


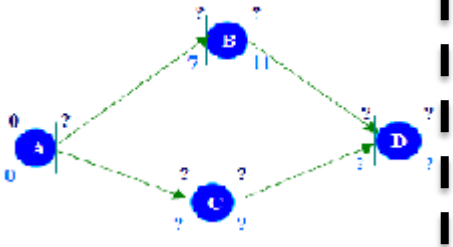
Run-N-3



Run-2



Run-6



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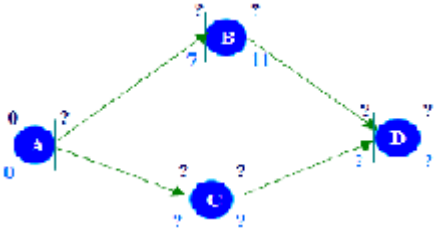
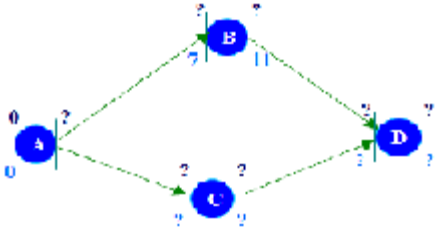
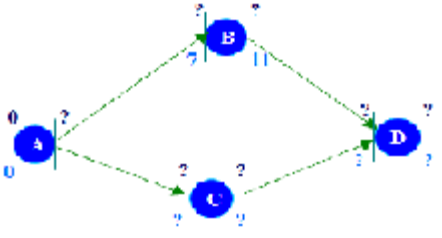


Run-N-2



Run-3



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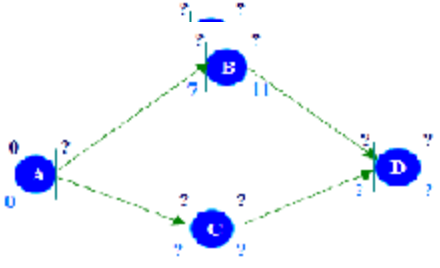

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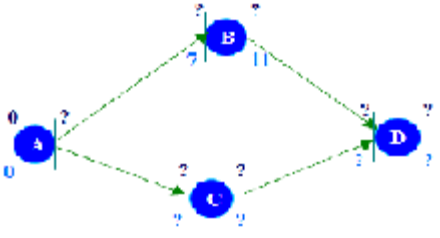
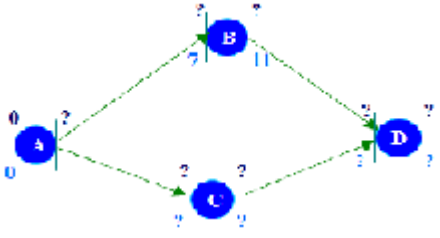
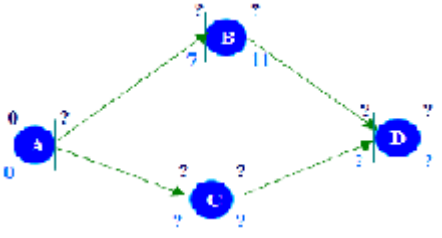


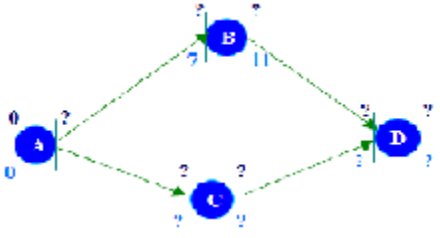
Run-N-1



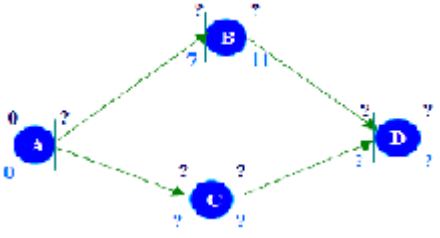
Run-4



Run-8



Run-12



Run-N

Historical Data & Simulation - Issues

- Not easily available
- Even when available – is it data appropriate for current activity/project ?
- Simulation approach is computing intensive – 1950’s mainframe had limitations
- Simulation is popular approach today!