PROBABILISTIC SCHEDULING

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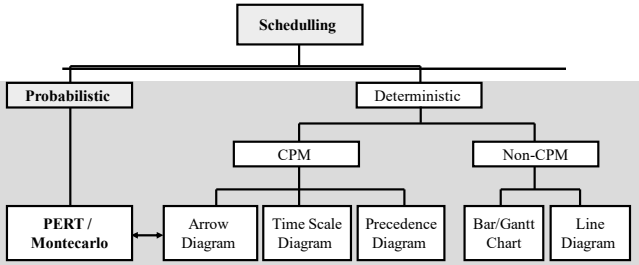
SCHEDULING TOOLS



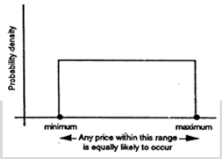
CPM : Critical Path Method
PERT : Program Evaluation Review Technique

PERT (PROGRAM EVALUATION REVIEW TECHNIQUE)

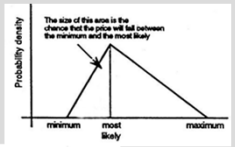
- **Perbedaan durasi deterministik & Probabilistik**
  - Deterministik : 1 type durasi *(d)*
  - Probabilistik : 3 type durasi *(a, m, b)*
- **Sumber perkiraan durasi**
  - Historical Information (pengalaman proyek yang lalu)
  - Observasi / pengamatan
  - Expert Judgement
- **Kemungkinan bentuk distribusi waktu**
  - Distribusi beta , Distribusi Triangular
  - Distribusi Normal , Distribusi Uniform
  - Dan sebagainya.

BENTUK DISTRIBUSI DURASI

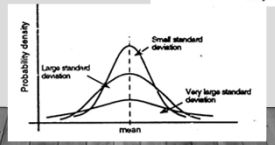
Uniform distribution



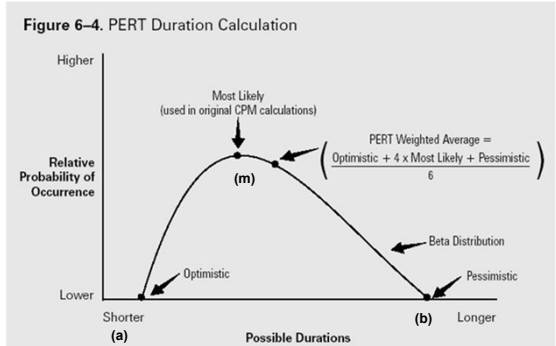
Triangular distribution



Normal distribution



BETA PERT DISTRIBUTION



Act	Pred	Duration			Mean	Std Dev	Variance
		Opt	M Likely	Pessimistic	Te	Sd	
A	-	2	3	7	3.5	0.83	0.69
B	A	3	4	8	4.5	0.83	0.69
C	A	5	6	10	6.5	0.83	0.69
D	B, C	3	4	5	4	0.33	0.11
E	C	2	3	7	3.5	0.83	0.69
F	D, E	6	8	10	8	0.67	0.44

Formulasi
Konversi beta PERT

$$te = \frac{(a + 4m + b)}{6}$$

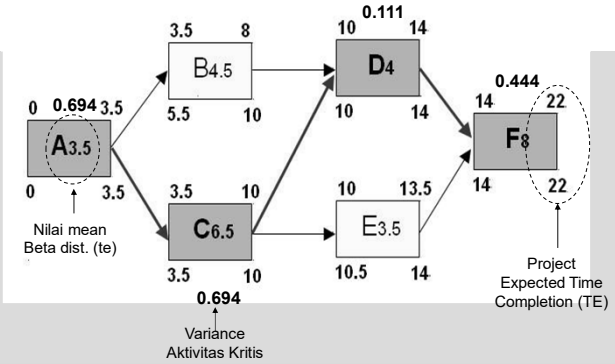
$$S_d = \frac{(b-a)}{6}$$

$$Var = \left[\frac{(b-a)}{6}\right]^2 = \frac{(b-a)^2}{36}$$

Masukkan nilai mean Beta dist. (te)
Sebagai pengganti (d) pada
Network scheduling (CPM)

a = Optimistic duration
m = Most likely duration
b = Pessimistic duration

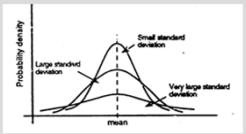
CPM NETWORK SCHEDULING



VARIASI PENYELESAIAN PROYEK

Var LK = Var A + var C + Var D + Var F
= 0.694 + 0.694 + 0.111 + 0.444
= 1.944

SD LK = $\sqrt{Var\ LK} = \sqrt{1.944} = 1.394$



Bila ada lebih dari 1 lintasan kritis (LK), maka diambil lintasan yang memiliki Variance terbesar.(Risk Lover Style)

PROBABILITAS PENYELESAIAN PROYEK

$$Z = \frac{Td - TE}{Sd\ LK}$$

Dimana :

- Z = Nilai pada Tabel Normal Distribusi
- Td = Target durasi
- TE = Project Expected Time Completion
- Sd LK = Standard Deviasi Lintasan Kritis

Misal Target penyelesaian 23 hari :

$$Z = \frac{Td - TE}{Sd\ LK} = \frac{23 - 22}{1.394} = 0.717$$

$$P(z = 0.717) = 76.327\%$$

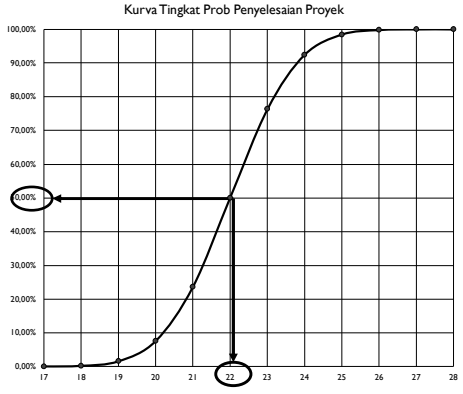
TABEL Z

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952

0.71 = 0.7611
0.72 = 0.7642
0.717 = 0.76327

KURVA PROBABILITAS

TD	Z	Probabilitas
17	-3.5857	0.02%
18	-2.8685	0.21%
19	-2.1514	1.57%
20	-1.4343	7.57%
21	-0.7171	23.66%
22	0.0000	50.00%
23	0.7171	76.34%
24	1.4343	92.43%
25	2.1514	98.43%
26	2.8685	99.79%
27	3.5857	99.98%
28	4.3028	100.00%



CONTOH

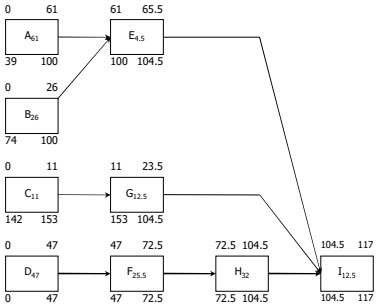
No	Activity	Predessor	Duration		
			Optimistic	Most Likely	Pessimistic
1	A	-	52	60	74
2	B	-	17	25	39
3	C	-	8	10	18
4	D	-	41	45	61
5	E	A, B	2	4	9
6	F	D	20	25	33
7	G	C	8	12	19
8	H	F	26	30	46
9	I	E, G, H	9	12	18

Tentukanlah juga berapa total penyelesaian proyek tersebut dengan tingkat kepercayaan 90%.

HITUNGAN

No	Activity	Predessor	Duration			Mean	Std Dev	Variance
			Optimistic	Most Likely	Pessimistic	Te	Sd	
1	A	-	52	60	74	61	3.67	13.444
2	B	-	17	25	39	26	3.67	13.444
3	C	-	8	10	18	11	1.67	2.778
4	D	-	41	45	61	47	3.33	11.111
5	E	A, B	2	4	9	4.5	1.17	1.361
6	F	D	20	25	33	25.5	2.17	4.694
7	G	C	8	12	19	12.5	1.83	3.361
8	H	F	26	30	46	32	3.33	11.111
9	I	E, G, H	9	12	18	12.5	1.50	2.250

PENYELESAIAN



PENYELESAIAN

Jalur kritis D, F, H, I

Var lintasan kritis = 11.111 + 4.694 + 11.111 + 2.25 = 29.166

SD = (29.166)^0.5

= 5.4

Target 90%, z = 1.28

$$Z = \frac{td - te}{SD}$$

$$1.28 = \frac{td - 117}{5.4}$$

Td = 123.912

≈ 124 satuan waktu

LATIHAN

Suatu proyek mempunyai aktivitas-aktivitas yang tertera pada tabel dibawah ini. Anda sebagai seorang engineer ditugas untuk membuat network.

Aktivitas	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Predecessors	-	A	A	-	B	C,D	C,D	D	H	F	E,J	F	G,I	G,I	L,N
Durasi (hari)	6	7	1	14	5	8	9	3	5	3	4	12	6	2	7

Pertanyaan:

Tentukan expected time project completion, jika durasi yang tercantum pada tabel diatas dianggap sebagai most likely, dan optimistic duration 2 hari lebih awal dari most likely, serta pessimistic duration 3 hari lebih lambat dari most likely. Tentukanlah juga berapa total penyelesaian proyek tersebut dengan tingkat kepercayaan 90%.

SELESAI

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