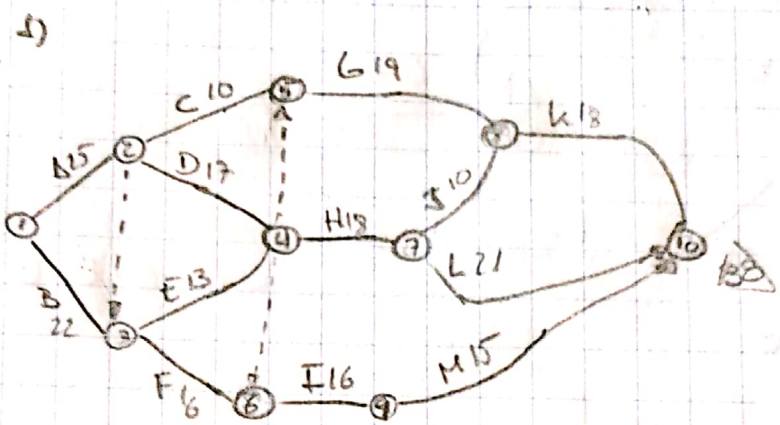
PROBLEMAS PROYECTOS

Grafos:

1. A → C, D, E, F
   B → E, F
   - C → G
   - D → G, H, I
   - E → G, H, I
   - F → I
   - G → K
   - H → J, L
   - I → M
   - J → K

a)



Coste penalización: 3200 um/u.t

Compromiso ejecución: 750 u.t

Penalización: (Total - compromiso) · Pen.

	A	B	C	D	E	F	G	H	I	J	K	L	M	①	②	③	④
A-C-G-K	20		15				20				40			72	72	69	69
A-D-G-K	20			15			20				40			79	75	72	72
A-D-H-J-K	20			15				35		32	40			88	84	81	75
A-D-H-L	20			15				35				12		81	76	73	73
A-D-I-M	20			15					40				18	73	69	66	66
A-E-G-K	20				5		20				40			75	75	72	72
A-E-H-J-K	20				5			35		32	40			84	84	81	75
A-E-H-L	20				5			35				12		77	77	74	74
A-E-I-M	20				5				40				18	69	69	66	66
A-F-I-M	20					7			40				18	72	72	69	69
B-E-G-K		10			5		20				40			72	72	72	72
B-E-H-J-K		10			5			35		32	40			81	81	81	75
B-E-H-L		10			5			35				12		74	74	74	74
B-E-I-M		10			5				40				18	66	66	66	66
B-F-I-M		10				7			40				18	69	69	69	69
①	4	4	2	4	3	4	4	6	6	8	6	4	4	Act		D	A	J
②	4	4	2	4	3	4	4	6	6	8	6	4	4	Dw	88	84	81	75
③	4	4	2	3	4	4	6	6	8	6	4	4		Rd	-	4	3	6
④	4	4	2	3	4	4	6	6	2	6	4	4		Coste	0	4.1.5	3.20	6.3.2
														Ac	0	60	120	312
														Pen	13.32	9.32	6.32	0
														Total	416	348	312	312

Examen Enero '19

Tiempo PERT = $\frac{op + pes + 4prob}{6} = \frac{a + b + 4m}{6}$

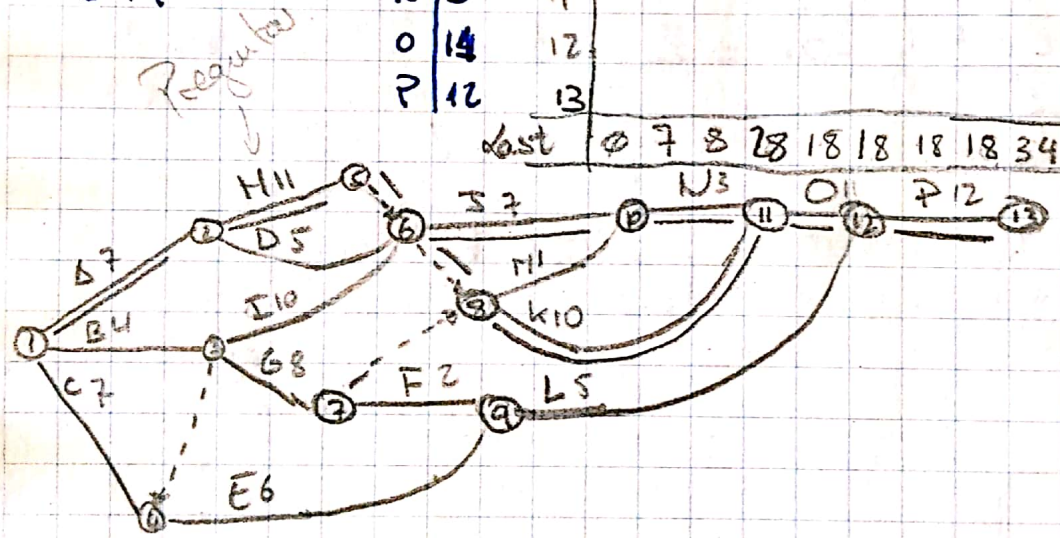
3) A → H, D
B → I, G, E
C → E
D → J, M, K
E → L
F → L
G → F, M, K
H → J, M, K
I → J, M, K
J → N
K → O
L → P
M → N
N → O
O → P

Act	T.PERT
A	7
B	4
C	7
D	5
E	6
F	2
G	8
H	11
I	10
J	7
K	10
L	5
M	1
N	3
O	14
P	12

a)

$\theta_i^2 = \left(\frac{b_i - a}{6}\right)^2$ → Solo del camino crítico

	1	2	3	4	5	6	7	8	9	10	11	12	13	Early
1		7	4	7										0
2					11	5								7
3				0		10	8							4
4									6					7
5						0								18
6								0		7				18
7								0	2					12
8										1	10			18
9												5		14
10											3			25
11												14		28
12													12	39
13														51
Last	0	7	8	28	18	18	18	18	34	25	28	39	51	



b) $P(45 \leq x \leq 48)$ x = "Duración del proyecto"

P-O-K-H-A
P-O-N-J-H-A

$\mu = 51$

$\theta_i^2 = \left(\frac{b_i - a}{6}\right)^2 = \left(\frac{16-8}{6}\right)^2 + \left(\frac{21-6}{6}\right)^2 + \left(\frac{12-8}{6}\right)^2 + \left(\frac{14-8}{6}\right)^2 + \left(\frac{13-5}{6}\right)^2 =$

$= 11'25$

$= \left(\frac{16-8}{6}\right)^2 + \left(\frac{21-6}{6}\right)^2 + \left(\frac{4-2}{6}\right)^2 + \left(\frac{8-6}{6}\right)^2 + \left(\frac{14-8}{6}\right)^2 + \left(\frac{13-5}{6}\right)^2 =$

$= 11'02$

→ Continues

$\beta \rightarrow$ C. penalización
$\alpha \rightarrow$ C. rebaja

$$P(X \leq z) = \frac{\beta}{\alpha+\beta}$$

Si $\alpha > \beta \rightarrow$ Δ la baja
Si $\alpha < \beta \rightarrow$ Δ al alza.

$X \sim N(51; \sqrt{11}) = N(51; \sigma = 3'316)$

$P(45 \leq x \leq 48) = P(X \leq 48) - P(X \leq 45) =$

$= P\left(Z \leq \frac{48-51}{3'316}\right) - P\left(Z \leq \frac{45-51}{3'316}\right) = 1 - P(Z \leq 0'904) - [1 - P(Z \leq 1'809)] =$

$= P(Z \leq 1'809) - P(Z \leq 0'904) = 0'9649 - 0'8159 = 0'149$

c) Coste de rebaja 50 u.m./u.t. Coste de penalización 40 u.m./u.t.

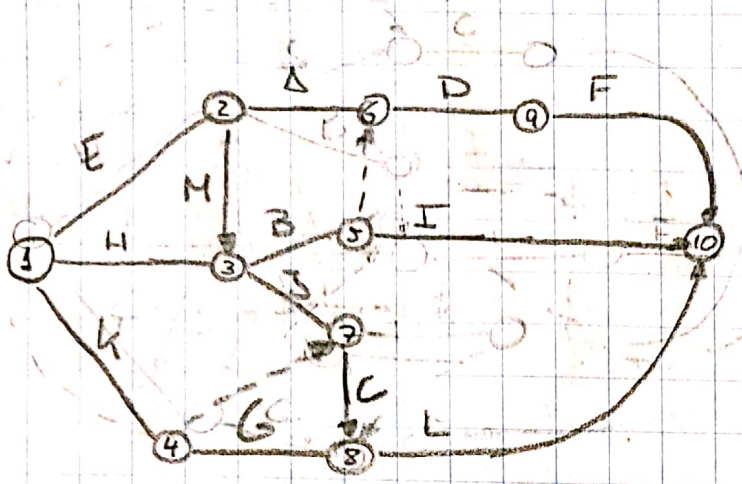
$$P(X \leq z) = \frac{40}{40+50} = 0'444 \rightarrow Z = -0'14$$

$$Z = \frac{z' - \mu}{\sigma} \; ; \; -0'14 = \frac{z' - 51}{3'316} \; ; \; z' = 50'53 \text{ u.t}$$

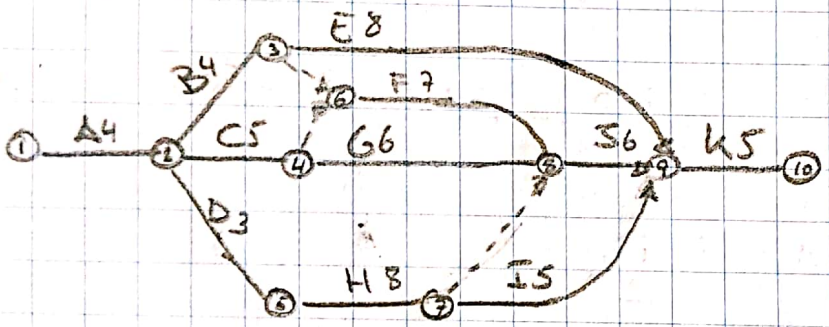
$z' = 50$ u.t

Repaso Grafos PERT

- A → D
- B → D, I
- C → L
- D → F
- E → A, M
- G → L
- H → B, J
- I → C
- K → C, G
- M → B, I

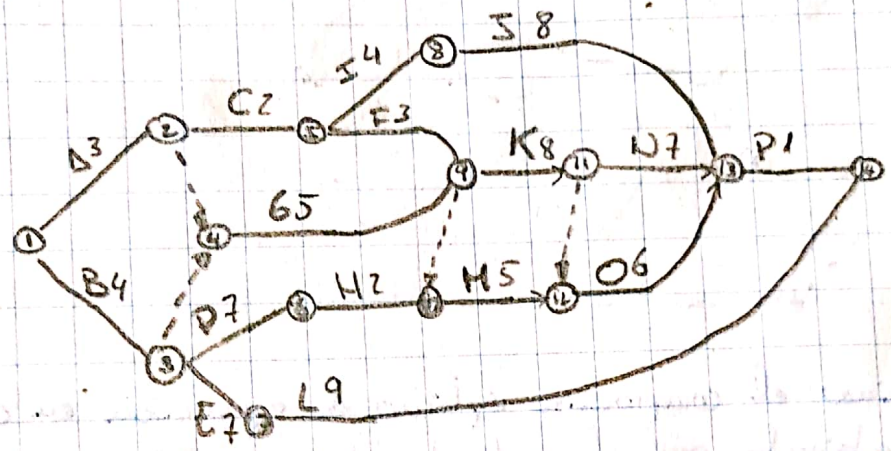


- A → B, C, D
- B → E, F
- C → G, F
- D → K
- E → K
- F → J
- G → J
- H → J, I
- I → K
- J → K



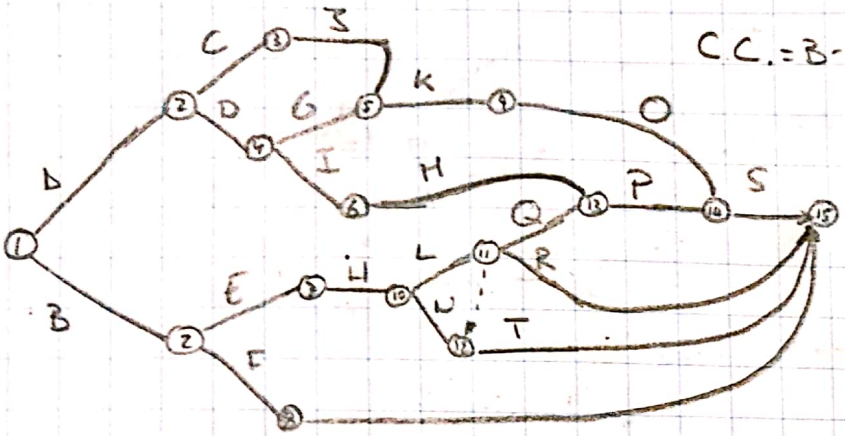
	1	2	3	4	5	6	7	8	9	10	Tearly
1	-	4									0
2		-	4	5	3						4
3			-			0			8		8
4				-				6			9
5					-		8				7
6						-		7			9
7							-	0	5		15
8								-	6		16
9									-	5	22
10										-	27
tlast	0	4	9	9	8	9	16	16	22	27	

A → C, G
B → D, E, G
- C → I, F
- D → H
- E → L
- F → K, M
- G → K, M
- H → M
- I → J
- J → P
- K → N, O
- M → O
- N → P
- O → P



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	tasks
1	-	3	4												0
2		-		0	2										3
3			-	0		7	7								4
4				-					5						4
5					-			4	3						5
6						-				2					11
7							-							9	11
8								-					8		9
9									-	0	8				9
10										-		5			13
11											-	0	7		17
12												-	6		18
13													-	1	24
14														-	25
tlast	0	4	4	4	6	11	16	16	9	13	17	18	24	25	

A → C, D
B → E, F
- C → J
- D → G, I
- E → H
- G → K
- H → L, N
- I → M
- J → K
- K → O
- L → Q, R, T
- M → P
- N → T
- O, P → S
- Q → P



C.C. = B-E-H-L-Q-P-S

1) Determina el compromiso óptimo de ejecución en contexto de riesgo, sabiendo que el coste de rebaja es 25 u.m./u.t. y el coste de penalización es de 30 u.m./u.t.

$$P(X \leq z) = \frac{\beta}{\alpha+\beta} = \frac{30}{25+30} = 0'545 \quad , \quad z = 0'12$$

Solo del C.C

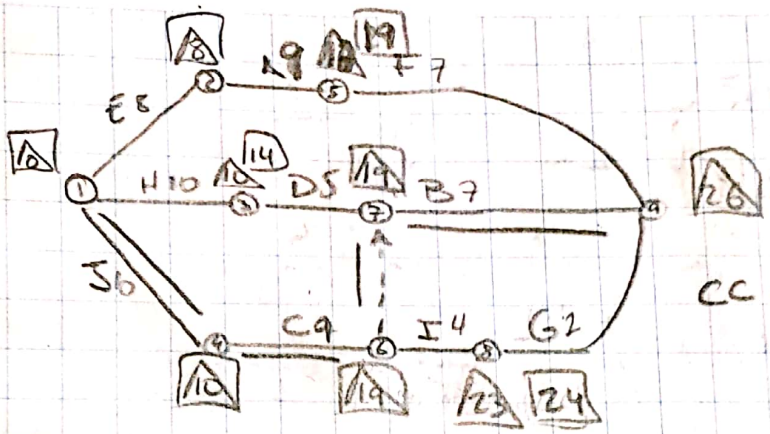
$$\sigma' = \sqrt{\left(\frac{4-2}{6}\right)^2 + \left(\frac{11-11}{6}\right)^2 + \left(\frac{1-1}{6}\right)^2 + \left(\frac{7-7}{6}\right)^2 + \left(\frac{5-3}{6}\right)^2 + \left(\frac{9-9}{6}\right)^2 + \left(\frac{3-1}{6}\right)^2} = 0'33$$

$\mu = 37$

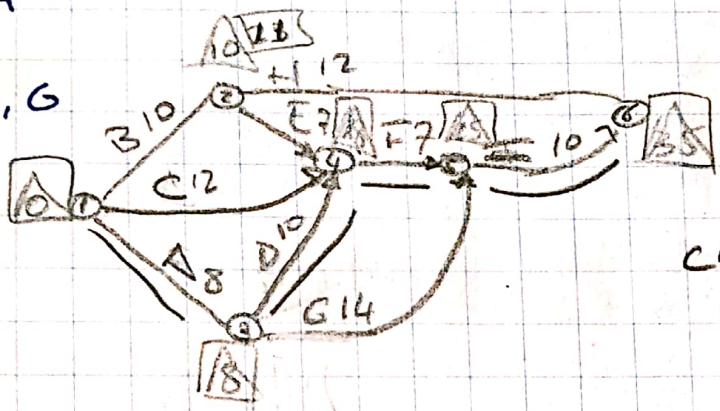
$$z = \frac{z' - 37}{0'33} \; ; \quad 0'12 = \frac{z' - 37}{0'33} \; ; \quad 37'04 = z'$$

Como $\beta > \alpha \Rightarrow 37'04 \simeq 38$

E → A
H → D
J → C
- A → F
- D → B
- C → B, I
- I → G



B → E, H
C → F
A → D, G
- E → F
- D → F
- G → I
- F → I



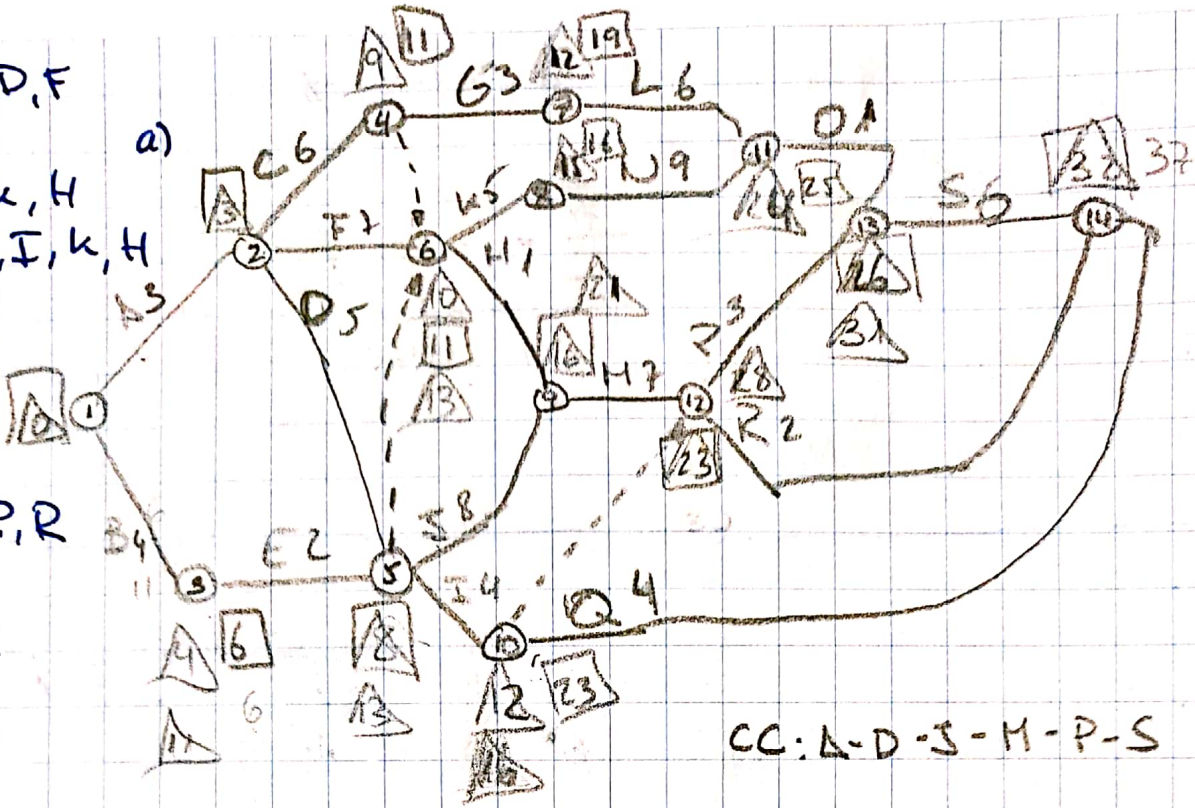
	A	B	C	D	E	F	G	H	I	①	②		
B-H		4				5		2		22	22	22	22
B-E-F-I		4			5	5			1	34	31	31	28
C-F-I			3			5			1	29	26	26	26
A-D-F-I	2			4		5			1	35	32	31	28
A-G-I	2						3		1	32	29	28	28
①	4	5	6	4	2	3	5	4	3				
	3	5	6	4	2	3	5	4					
	3	5	6	4	2	3	2	4					

Activity	-	I	A	F	A,B
Duration	35	32	31	28	
Cost	-	3	1	3	
Crash	0	31	1.2	3.5	
Crash Cost	0	3	5	20	
Normal	-	3			
Normal Cost	-				

Ejercicio dos (Dive)

- A → C, D, F
- B → E
- C → G, K, H
- D, E → J, I, K, H
- F → K, H
- G → L
- H, S → M
- K → N
- I → Q, P, R
- L, N → O
- M → P, R
- O, P → S

a)



CC: A-D-J-M-P-S

Act	PERT
A	3
B	4
C	6
D	5
E	2
F	7
G	3
H	1
I	4
J	8
K	5
L	6
M	7
N	9
O	1
P	3
Q	4
R	2
S	6

b)

i \ j	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1	-	3	4												0
2		-		6	5	7									3
3			-		2										4
4				-		0	3								9
5					-	0			8	4					8
6						-		5	1						10
7							-				6				12
8								-			9				15
9									-			7			16
10										-		0		4	12
11											-		1		24
12												-	3	2	63
13													-	6	26
14														-	32
	0	3	6	11	8	11	19	16	16	25	25	23	26	32	

c)

N_1	N_2	Δ	H^T	H^L	H^I
→ 1	2	A	0		
1	3	B	2		
2	4	C	2		
2	6	F	1		
→ 2	5	D	0		
4	7	G	7		
4	6	F_1	2		
5	6	F_2	3		
→ 5	9	S	0		
6	8	K	1		
6	9	H	5		
7	11	L	7		
8	11	N	1		
→ 9	12	M	0		
10	12	E_2	11		
10	14	Q	16		
11	13	O	1		
→ 12	13	P	0		
12	14	R	7		
→ 13	14	S	0		
3	5	E	0		

$\Delta = 0 + 3 - 3 = 0$

g) Se crea un nuevo C.C. = B-E-S-M-P-S
$d_{us} = 37$

P

$\theta_2^2 = \left(\frac{10-2}{6}\right)^2 + \left(\frac{0}{6}\right)^2 + \left(\frac{15-1}{6}\right)^2 + \left(\frac{12-2}{6}\right)^2 + \left(\frac{4-2}{6}\right)^2 + \left(\frac{15-1}{6}\right)^2 = 15'55$

$\theta_1^2 = \left(\frac{4-2}{6}\right)^2 + \left(\frac{6-4}{6}\right)^2 + \left(\frac{15-1}{6}\right)^2 + \left(\frac{12-2}{6}\right)^2 + \left(\frac{4-2}{6}\right)^2 + \left(\frac{15-1}{6}\right)^2 = 14$

$\pi \sim N(32, \sqrt{14})$ → Utilizamos el paso CC

$P(X > 37) = P\left(Z' > \frac{37-32}{\sqrt{14}}\right) = P(Z' > 1'33) =$

$= 1 - P(Z' \leq 1'33) = 1 - 0'9082 = 0'0918$

g) Si, que excluya otro CC: B-E-S-M-P-S y CC_1

h) $P(X < 30) = P(X > 34) = 1 - P(X \leq 34) = 1 - P\left(Z \leq \frac{34-32}{\sqrt{14}}\right) =$

$= 1 - P(Z \leq 0'53) = 1 - 0'7019 = 0'2981$

i) $P(X \leq 32) = 0'5$ ya que es la mitad

j) $P(30 \leq X \leq 40) = P(X \leq 40) - P(X \leq 30) = P\left(Z \leq \frac{40-32}{\sqrt{14}}\right) - P\left(Z \leq \frac{30-}{\sqrt{14}}\right)$

$= P(X \leq 2'138) - P(Z \leq -0'534) = 0'9901 - 0'2981 = 0'692$

k) $P(\bar{X} \leq \bar{D}) = 0'8$

$$\frac{z' - 32}{\sqrt{14}} = 0'8 \;;\; z = 35'99 \simeq 35 \text{ días}$$

l) $\alpha \rightarrow$ Rebaja $\rightarrow$ 200 u.m/u.t

$\beta \rightarrow$ Penalización $\rightarrow$ 150 u.m/u.t

$$P(\bar{X} \leq z) = \frac{\beta}{\alpha + \beta} = \frac{150}{200 + 150} = 0'4285 \quad z = -0'18$$

$$-0'18 = \frac{z' - 32}{\sqrt{14}} \;;\; z' = 31'32 \text{ Como } \alpha < \beta \Rightarrow 31 \text{ u.t}$$

m) Compromiso óptimo de ejecución en situación de incertidumbre

$[22, 34]$

$\alpha \rightarrow$ 200 u.m/u.t

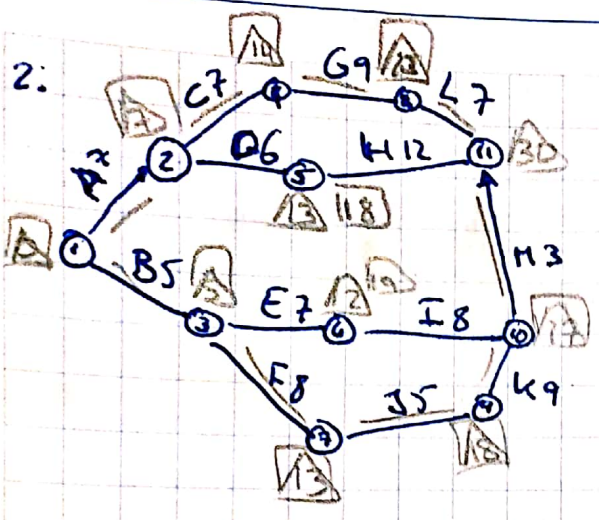
$\beta \rightarrow$ 150 u.m/u.t

	28	29	30	31	32	33	34	$\bar{z}$
28	0	150	300	450	600	750	900	900
29	200	0	150	300	450	600	750	750
30	400	200	0	150	300	450	600	600
31	600	400	200	0	150	300	450	600
32	800	600	400	200	0	150	300	800
33	1000	800	600	400	200	0	150	1000
34	1200	1000	800	600	400	200	0	1200

Cogemos el menor

Compromiso óptimo 30 u.t

2:



CC: A-C-G-L
B-F-J-KM

Gruppo	A	B	C	D	E	F	G	H	I	J	K	L	M	0	①	②	③	④	⑤	⑥	⑦	⑧
→ A-C-G-L	5		3				2					5		30	27	26	25	23	22	20	17	
A-D-H	5			2				6						25	25	25	25	23	22	20	17	
B-E-F-M		3			1				1				3	20	20	20	20	17	17	17		
→ B-F-J-L-M		3				4				4	2		3	30	27	26	25	23	22	20	17	

	A	B	C	D	E	F	G	H	I	J	K	L	M
①	3	2	4	2	5	3	3	5	5	2	4	3	2
②	3	2	4	2	5	3		5	5	2	1	3	2
③	3	2	3	2	5	3		5	5	2		3	2
④	3	2	2	2	5	3		5	5	2		3	1
⑤	3				5	3		5	5	2		3	1
⑥	2				5	3		5	5	2		3	
⑦					5	3		5	5			3	
⑧					5			2	5				

	0	①	②	③	④	⑤	⑥	⑦	⑧
Act		G,K	K,L	C,G,M	B,C,D	A,M	A,J	A,H	F
Dur	30	27	26	25	23	22	20	17	
Rel		3	1	1	2	1	2	3	
Cat		3-2	1-3	1-3	2-3	1-5	2-4	3-5	
		3-2	1-2	1-3	2-3	1-3	2-5	3-6	

A → 6
B →
C → 5
D →
E →
F →
G → 6
H →
I →
→ J →
K → 5
L →
M →

Ejemplo 3: Pagos = 40.000 + 500 p^nº de uds. Ventas: año 1 60 uds
año 2 90 uds
año 3-15 100 uds

k_0 = 60 k
k_1 = 50 k
90 k al 4%. años 7-10

i_{1-8} = 5%
i_{9-15} 3%.

PUP (sin cuota) = 1250 €/uds

a) VAN, Q, TIR y precio de producto para que sea rentable.

$C_{11} = 1250 \cdot 60 = 75000$ $\quad P_{11} = 40.000 + 500 \cdot 60 = 70.000$

$C_{22} = 1250 \cdot 90 = 112500$ $\quad P_{22} = 40000 + 500 \cdot 90 = 85000$

$C_{3_{3-15}} = 1250 \cdot 100 = 125000$ $\quad P_{3_{3-15}} = 40000 + 500 \cdot 100 = 90000$

$R_1 = C_{11} - P_{11} = 75000 - 70000 = 5000$

$R_2 = C_{22} - P_{22} = 112500 - 85000 = 27500$

$R_3 = C_{3_{3-15}} - P_{3_{3-15}} = 125000 - 90000 = 35000$

$$Q = \frac{90000}{\sum_1^{15} \frac{1}{1'04^j}} = 24794'1$$

$$VAN = -60000 - \frac{50000}{1'05} - 24794'1 \cdot \sum_7^8 \frac{1}{1'05^j} - \frac{24794'1}{1'05^8} \cdot \sum_1^2 \frac{1}{1'03^j} +$$

$$+ \frac{5000}{1'05} + \frac{27500}{1'05^2} + 35000 \cdot \sum_3^8 \frac{1}{1'05^j} + \frac{35000}{1'05^8} \cdot \sum_1^7 \frac{1}{1'03^j} =$$

$$= -174'13 + 4'7619 + 24'94 + 161'13 + 147'59$$

$$= 169'2919$$

$$Q = \frac{169'2919}{174'13} = 0'97 \quad 97\% \rightarrow 1€ \rightarrow 0'97€$$

b) ~~Calcula~~

$$TIR = -60 - \frac{50}{\lambda} - 24'7941 \cdot \sum_{7}^{10} \frac{1}{\lambda} + \frac{5}{\lambda} + \frac{27'5}{\lambda^2} + 35 \cdot \sum_{3}^{15} \frac{1}{\lambda} = \phi$$

$VAN(9\%) = 124'55$ $\quad VAN(10\%) = 82'92$

$VAN(4\%) = 174'25$

$TIR = 14'5\%$

$C_{1_1} = 60p = 0'06p$

$C_{2_2} = 90p = 0'09p$ $VAN = -60 - \frac{50}{1'05} - 24'7941 \sum_{7}^{8} \frac{1}{1'05} - \frac{24'7941}{1'05^3} \sum_{1}^{2} \frac{1}{1'05}$

$C_{3_{3-15}} = 100p = 0'1p + \frac{(0'06p - 70)}{1'05} + \frac{(0'09p - 85)}{1'05^2} + (0'1p - 90) \cdot \sum_{3}^{8} \frac{1}{1'05^3} +$

$+ \frac{(0'1p - 90)}{1'058} \sum_{1}^{7} \frac{1}{1'03^3}$

$p = 1089'06$

b) Calcular la cuota anual a pagar por un prestamo de 30.000€ a 5 años al 10%. El tercer año se revisa el interes y se cambia al 8% en los años 4-5. Determinar la nueva cuota y el interés equivalente de todo el prestamo.

$a = \frac{30000}{\sum_{1}^{5} \frac{1}{1'1^5}} = 7913'92$ → Pendiente$_{i-1}$ − Capital$_i$ a-interés

$a = \frac{30000}{\sum_{1}^{5} \frac{1}{1'08^5}}$

Año	Pendiente	interés	Capital	Cuota
1	30 000 →	3.000	4913'92	7913'92
2	25086'08	2508'608	5405'31	7913'92
3	19680'78	1968'078	5945'842	7913'92
4	13734'93	1098'79	6603'33	7702'12 → Se calcula de nuevo la anualidad con el pendiente como nuevo
5	7131'6	570'53	7131'6	7702'12

Tienen que ser iguales, sino, está mal

Ejemplo 1.

$k_0 = 30 \cdot 10^6$ $\quad 20 \cdot 10^6$ años 7-11, 10%

$k_1 = 20 \cdot 10^6$

$k_2 = 10 \cdot 10^6$ $\quad P = 5 \cdot 10^6 + 100p$ $\quad PVP = 200 €/ud.$

Ventas $\quad$ año 1-5 = 1000 ud/día $\quad$ 230 laborables

año 6-20 = 1500 uds/día

$C_{1-5} = 1000 \frac{ud}{día} \cdot 200 \frac{€}{ud} \cdot 230 \text{ días} = 46\,10^6$

$C_{6-20} = 1500 \cdot 200 \cdot 230 = 69 \cdot 10^6$

$P_{1-5} = 5\,10^6 + 100 \cdot (1000 \cdot 230) = 28\,10^6$

$P_{6-20} = 5 \cdot 10^6 + 100 \cdot (1500 \cdot 230) = 39'5 \cdot 10^6$

$$a = \frac{20\,10^6}{\sum_1^5 \frac{1}{1'1^j}} = 5'276$$

$$VAN = -30 - \frac{20}{1'1} - \frac{10}{1'1^2} - 5'276 \cdot \sum_7^{11} \frac{1}{1'1^j} + (46-28) \sum_1^5 \frac{1}{1'1^j} +$$

$$+ (69-39'5) \cdot \sum_6^{20} \frac{1}{1'1^j} =$$

$$= -67'73 + 68'2342 + 139'32 = 139'82$$

$$Q = \frac{139'82}{67'73} = 2'06$$

$$TIR; -30 - \frac{20}{\lambda} - \frac{10}{\lambda^2} - 5'276 \sum_7^{11} \frac{1}{\lambda^j} + 18 \sum_1^5 \frac{1}{\lambda^j} + 29'5 \cdot \sum_6^{20} \frac{1}{\lambda^j} = \emptyset$$

$\lambda = 15\%$ $\quad VAN = 83$ $\quad \lambda = 20\%$ $\quad VAN =$

$\lambda = 17\%$ $\quad VAN = 68'24$

b) Análisis de sensibilidad sobre el precio del producto.

$C_{1-5} = 1000 \cdot 230 \cdot p = 230 \cdot 10^3 p \xrightarrow{\div 10^6} 0'23p$

$C_{6-20} = 1500\ 230\ p = 0'345p$

$$VAN = -30 - \frac{20}{1'1} - \frac{10}{1'1^2} - 5'276 \cdot \sum_{2}^{5} \frac{1}{1'1^j} + (0'23p - 28) \cdot \sum_{1}^{5} \frac{1}{1'1^j} + (0'345p - 89'5) \sum_{6}^{20} \frac{1}{1'1^j} = 0$$

$p = 144'1\ €$

12'188

Ejemplo 2:

$k_0 = 50 \cdot 10^6$ $\quad i_{1-3} = 12\%$ $\quad i_{6-12} = 8\%$ $\quad$ año 5-8 $20 \cdot 10^6$ al 10%.

$k_1 = 50 \cdot 10^6$ $\quad i_{4-5} = 10\%$.

$C_{1-5} = 70 \cdot 10^6$ $\quad P_{1-5} = 50 \cdot 10^6$ $\quad R_{1-5} = 20 \cdot 10^6$

$C_{6-12} = 90 \cdot 10^6$ $\quad P_{6-12} = 60 \cdot 10^6$ $\quad R_{6-12} = 30 \cdot 10^6$

$$a = \frac{20}{\sum_{1}^{3} \frac{1}{1'1^j}} = 8'04$$

$$VAN = -50 - \frac{50}{1'12} - \frac{8'04}{1'1^2 \cdot 1'12^3} \cdot \sum_{1}^{3} \frac{1}{1'08^j} + 20 \cdot \sum_{1}^{3} \frac{1}{1'12^j} + \frac{20}{1'12^3} \cdot \sum_{1}^{2} \frac{1}{1'1^j} + \frac{30}{1'12^3 \cdot 1'1^2} \cdot \sum_{1}^{7} \frac{1}{1'08^j} =$$

Problema_EF

1) $k_0 = 250.000$ $\quad i = 12\%$

$k_1 = 250.000$

$C_1 = 80.000$ $\quad P_1 = 150.000$

$C_2 = 100.000$ $\quad P_2 = 150.000$

$C_3 = 200.000$ $\quad P_3 = 150.000$

$C_{4-6} = 250.000$ $\quad P_{4-6} = 150.000$

$C_{7-10} = 350.000$ $\quad P_{7-10} = 200.000$

$$VAN = -250 - \frac{250}{1'12} + \frac{-70}{1'12} - \frac{50}{1'12^2} + \frac{50}{1'12^3} + 100 \cdot \sum_{4}^{6} \frac{1}{1'12^3} + 150 \cdot \sum_{7}^{10} \frac{1}{1'12^3} =$$

$$= -138'20$$

$$Q = \frac{138'2}{473'21} = 0'29 \qquad \text{No es rentable}$$

$$TIR: \quad -250 \cdot \frac{250}{\lambda} + \frac{-70}{\lambda} - \frac{50}{\lambda^2} + \frac{50}{\lambda^3} + 100 \cdot \sum_{4}^{6} \frac{1}{\lambda^3} +$$

$$+ 150 \sum_{7}^{10} \frac{1}{\lambda^3} = \phi$$

$$TIR = 3\%$$

2) $k_0 = 500.000$
$i = 8\%$

$$VAN = -500 + \frac{-200}{1'08} + \frac{-100}{1'08^2} + \frac{0}{1'08^3} + \frac{125}{1'08^4} + \frac{190}{1'08^5} + \frac{170}{1'08^6} + \frac{165}{1'08^7} +$$

$$+ \frac{165}{1'08^8} + \frac{160}{1'08^9} + \frac{160}{1'08^{10}} = -103'029$$

No es rentable

$\lambda = 3\% \rightarrow VAN = 134$ $\lambda = 6\% \rightarrow VAN = -19'54$

$\lambda = 5\% \rightarrow VAN = 27'68$

$TIR = 5'5\%$

3) $k_0 = 11.000.000/2$ $P_{4-20} = 5.000.000$ $i = 11\%$
$k_1 = 11.000.000/2$ $C_{4-20} = 10.000.000$

$$VAN = -5'5 - \frac{5'5}{1'11} + 5 \cdot \sum_{4}^{20} \frac{1}{1'11} = 17'143$$

$$Q = \frac{17'143}{10'4599} = 1'6 \Rightarrow \text{Es rentable al ser } Q > 1$$

$$-5'5 - \frac{5'5}{1'24} + (0'05p - 5) \sum_{4}^{20} \frac{1}{1'24} = 0, \quad p = 193'34$$

$K_0 = 15 \cdot 10^6$
$K_1 = 20 \cdot 10^6$

$30 \cdot 10^6$ al 5% años 4-7

$R_{1-8} = 10 \cdot 10^6$ $\quad i_{1-9} = 6\%$ $\quad g_{1-5} = 3\%$
$R_{9-15} = 12 \cdot 10^6$ $\quad i_{10-15} = 7\%$ $\quad g_{6-15} = 2\%$

$\mu_{1-5} = 3\%$
$\mu_{6-9} = 4\%$
$\mu_{10-15} = 5\%$

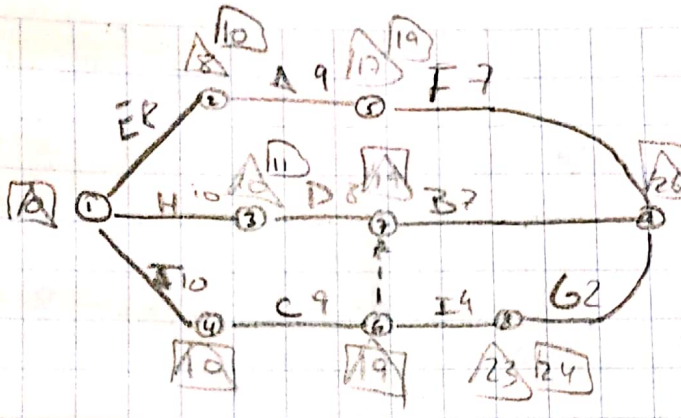
$$a = \frac{30}{\sum_1^{11} \frac{1}{1'05^i}} = 8'46$$

$$VAN = -15 - \frac{20}{1'03} - \frac{8'46}{1'03^2} \cdot \sum_1^2 \frac{1}{1'03^i} - \frac{8'46}{1'03^5} \cdot \sum_1^2 \frac{1}{1'04^i} + \quad (-62'99)$$

$$- 40 - 80 \cdot \sum_1^5 \frac{1}{1'03^i} + \frac{10}{1'03^5} \cdot \sum_1^3 \frac{1}{1'04^i} + \frac{12}{1'03^5 \cdot 1'04^4} + \frac{12}{1'03^5\ 1'04^4} \cdot \sum_1^6 \frac{1}{1'05^i}$$

$$= 60'5$$

E → A
H → D
J → C
A → F
D → B
C → B, I
I → G



CC: 5 - C - B

Act	t_a	t_r	cor
A	9	6	3
B	7	4	5
C	9	7	9
D	8	5	6
E	8	6	3
F	7	4	5
G	2	1	2
H	10	6	4
I	4	2	2
J	10	7	3

Compresores 20 u.t
Pers: 10 o. in

Caminos	A	B	C	D	E	I	G	H	I	J	①	②	③	④	
E-A-F	3				3	5					24	24	24	22	20
H-D-B		5		6				4			25	25	24	22	20
→ J-C-B		5	9							3	26	25	24	22	20
J-C-I-G			9				2		2	3	25	24	24	22	20

											Act	∞	J	B	A,H,J	E,B,I
①	3	3	2	3	2	3	1	4	2	3	Pw	26	25	24	22	20
②	3	3	2	3	2	3	1	4	2	2	Rel	-	1	1	2	2
③	3	2	2	3	2	3	1	4	2	2	Cost	∞	1.3	1.5	2.3 2.3 2.4	2.3 2.2 2.5
	1	2	2	3	2	3	1	2	2	∅	Δc	∅	3	8	28	48
											Pen	6 10	5 10	9 10	7 10	∅
											Total	60	53	48	48	48

$P(48 \leq X \leq 55)$

$P(X \leq 55) - P(X \leq 48) =$

$\mu = 56$

$\theta^2_{cc1} = 3.22$

$\theta^2_{cc2} = 1.22$

=

EF-Iñaki.

1) $k_0 = 300.000$

años 1, 2, 3 mantenimiento 3.000€/ud.

50, 30, 20, 10, 5, 2, 1

a) $i = 8\%$

Coste = ud. (p - mant)

$$VAN = -300 + \frac{50\cdot(p-3)}{1'08} + \frac{30\cdot(p-3)}{1'08^2} + \frac{20(p-3)}{1'08^3} + \frac{10p}{1'08^4} + \frac{5p}{1'08^5} + \frac{2p}{1'08^6} + \frac{p}{1'08^7};$$

$$VAN = -300 + \frac{50p}{1'08} - \frac{50\cdot3}{1'08} + \frac{30p}{1'08^2} - \frac{30\cdot3}{1'08^2} + \frac{20p}{1'08^3} - \frac{20\cdot3}{1'08^3} + \frac{10p}{1'08^4} - \frac{5p}{1'08^5} + \frac{2p}{1'08^6} + \frac{p}{1'08^7}$$

$$0 = 100'49p - 563'6793 \;;\; p = 5'6093, \text{ como son miles}$$

$$p = 5609'30 \text{ u.}$$

2) $k_0 = 30.000.000$

$k_1 = 50.000.000$ 50.000.000 años 2, 3, 4 al 10%.

$P_{1-5} = 30.000.000$ $C_{1-5} = 40.000.000$ $i = 8\%$

$P_{6-15} = 50.000.000$ $C_{6-15} = 70.000.000$

$$a = \frac{50}{\sum_1^3 \frac{1}{1'1^i}} = 20'10$$

$R_{1-5} = 10.000.000$

$R_{6-15} = 20.000.000$

$$VAN = -30 - \frac{50}{1'08} - 20'1\cdot\sum_2^4 \frac{1}{1'08^i} + 10\cdot\sum_1^5 \frac{1}{1'08^i} + 20\cdot\sum_6^{15} \frac{1}{1'08^i} = -124'25 + 131'26$$

$$VAN = 7'0124 \qquad Q = \frac{7'0124}{124'25} = 0'0556 = 5'64\%$$

$$a_{\text{inversión}} = \frac{7'0124}{\sum_1^5 \frac{1}{1'08^i}} = 0'819$$

EF. Examen

$k_0 = 15 \cdot 10^6$ $\quad i_{1-9} = 6\%$ $\quad g_{1-5} = 3\%$ $\quad R_{1-8} = 10 \cdot 10^6$

$k_1 = 20 \cdot 10^6$ $\quad i_{10-15} = 7\%$ $\quad g_{6-15} = 2\%$ $\quad R_{9-15} = 12 \cdot 10^6$

$B0 \cdot 10^6$ al 5%. anos 4, 7.

$\mu_{1-5} = 3\%$

$\mu_{5-9} = 4\%$ $\qquad a = \dfrac{30}{\sum_1^4 \frac{1}{1'05^i}} = 8'46$

$\mu_{10-15} = 5\%$

$$VAN = -15 - \frac{20}{1'03} - \frac{8'46}{1'03^3}\sum_1^2 \frac{1}{1'03^3} - \frac{8'46}{1'03^5}\cdot\sum_1^2 \frac{1}{1'03^i} + 10\cdot\sum_1^5 \frac{1}{1'03^i} + \frac{10}{1'03^5}\cdot\sum_1^3 \frac{1}{1'04^i}$$

$$+ \frac{12}{1'03^5\cdot 1'04^4} + \frac{12}{1'03^5\cdot 1'04^4}\cdot\sum_1^6 \frac{1}{1'05^i} = -62'99 + 69'73 + 83'75 = 60'49$$

$$Q = \frac{60'49}{62'99} = 0'96$$

$$TIR = -15 - \frac{20}{\lambda} - 8'46\sum_4^7 \frac{1}{\lambda^i} + 10\sum_1^8 \frac{1}{\lambda^i} + 12\sum_9^{15} \frac{1}{\lambda^i} = \emptyset$$