[illegible] 656.222

[illegible] 2, [illegible] 49010

[illegible]

[illegible] 7. [illegible] 17 [illegible]

[illegible]

[illegible]

[illegible]

[illegible].

[illegible]

[illegible] [1 ï 3]. [illegible] [4 ï 7]. [illegible] [8].

[illegible]

[illegible] [8] [illegible] [9]. [illegible].

[illegible] [2 ï 4, 10 ï 11], [illegible]

[illegible] (1).

[illegible]:

$$C = \sum_{i,j \in V} \sum_{\omega \in W_{ij}} X_{ij\omega} \cdot l(\omega) \to \min\,, \tag{1}$$

[illegible] $l(\omega)$ – [illegible] ω;

$\sum_{\omega \in W_{ij}} X_{ij\omega}$ [illegible] $G(V,E)$.

[illegible]

[illegible].

[illegible] $G(V,E)$ – [illegible] V [illegible] E. [illegible] $R(e)$.

[illegible] $G(V,E)$ [illegible] P_{ij}, $i, j \in V$.

[illegible] W_{ij} – [illegible] i [illegible] j, ω – [illegible] W_{ij}.

[illegible] $X_{ij\omega}$ [illegible] P_{ij}, [illegible] ω, [illegible]

$$\sum_{\omega \in W_{ij}} X_{ij\omega} = P_{ij}\;. \tag{2}$$

[illegible] e [illegible] ω, [illegible]

$$I_{\omega}(e) = \begin{cases} 1, & \text{[illegible]}\ e \in \omega; \\ 0, & \text{[illegible]}\ e \notin \omega, \end{cases} \tag{3}$$

[illegible] e [illegible] W_{ij} [illegible]

$$\sum_{\omega \in W_{ij}} X_{ij\omega} \cdot I_{\omega}(e), \qquad (4)$$

[illegible] e [illegible]

$$N(e) = \sum_{i,j \in V} \sum_{\omega \in W_{ij}} X_{ij\omega} \cdot I_{\omega}(e); \; e \in E. \qquad (5)$$

[illegible] $\bar{N}(e)$ [illegible]:

$$N(e) \le \bar{N}(e), \; e \in E. \qquad (6)$$

[illegible] $l(\omega)$ [illegible] ω, $l(\omega) = \sum_{e \in \omega} R(e)$, [illegible]

$$Pr = \sum_{i,j \in V} \sum_{\omega \in W_{ij}} X_{ij\omega} \cdot l(\omega) \qquad (7)$$

[illegible] P_{ij}, $i, j \in V$ [illegible] $G(V,E)$.

[illegible] E_* [illegible]

$$L(E_*) = \sum_{e \in E_*} R(e) \qquad (8)$$

[illegible].

[illegible] $X_{ij\omega}$, [illegible] $Pr(E_*)$ [illegible] $L(E_*)$ [illegible] (2) [illegible] (6).

[illegible]

$$\begin{pmatrix} L(E_*) \\ Pr(E_*) \end{pmatrix} \to \min, \qquad (9)$$

[illegible] (2) [illegible] (6).

[illegible], [illegible] $\sum_{i,j \in V}$ [illegible] $i < j$, [illegible],

[illegible] ([illegible]), [illegible] $i > j$,

[illegible] ([illegible]).

[illegible] $G(V,E)$ [illegible],

[illegible], [illegible] $R(e)$ – [illegible], [illegible] P_{ij} [illegible]

[illegible] i [illegible] j [illegible] e, [illegible] $L(E_*)$ [illegible]

[illegible], [illegible] $Pr(E_*)$ [illegible]

[illegible] [12 – 14].

[illegible]
$(i \to j)$

[illegible]:

$$\min_{e \in E \setminus E_*} \frac{Pr(E_* \cup \{e\}) - Pr(E_*)}{l(E_* \cup \{e\}) - l(E_*)}. \qquad (10)$$

[illegible]

[illegible] 1.

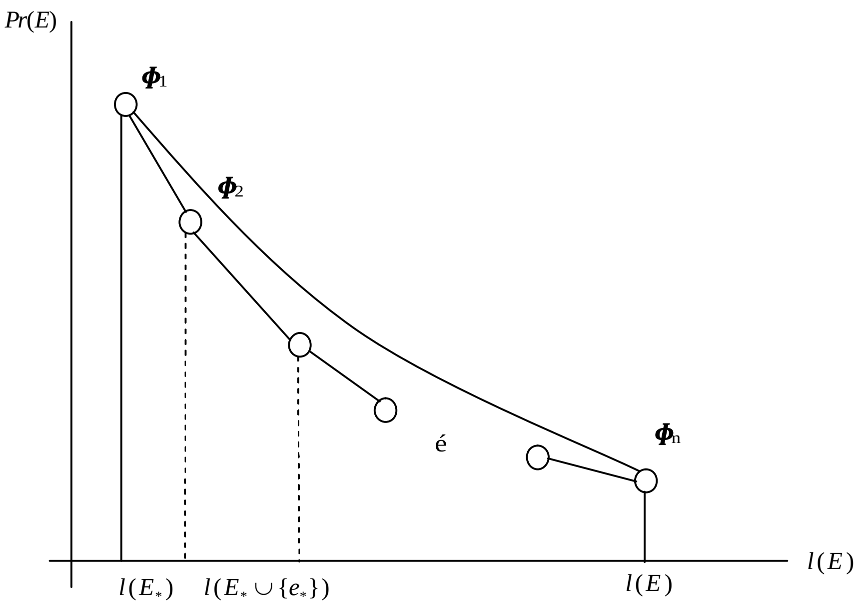
[illegible] e_* [illegible], [illegible] $E_* = E_* \cup \{e_*\}$, [illegible]

[illegible] A_2 ([illegible] 1) [illegible]. [illegible] $\left|E \setminus E_*\right| + 1$.

[illegible], [illegible] $Pr(E_* \cup \{e\}) \le Pr(E_*)$ [illegible] $L(E_* \cup \{e\}) \le L(E_*)$.

[illegible] i [illegible] j [illegible]

$(i \to j)$ [illegible] $N(N+1)/2$, [illegible] $N = \left|V\right|$.



[illegible] 1 [illegible] i [illegible] j

[illegible]

[illegible] N [illegible] $G(V,E)$; zn [illegible] zk [illegible] zn [illegible] zk.

1) [illegible] KP [illegible]; KW [illegible].

2) [illegible] zn [illegible] zk. [illegible] $KW = \{\{zn\}\}$.

3) [illegible] $w \in KW$ [illegible] KW.

4) [illegible] $z_1, z_2, \ldots, z_p$ [illegible] w.

5) [illegible] z_i, $i = \overline{1, p}$, $p < N$:

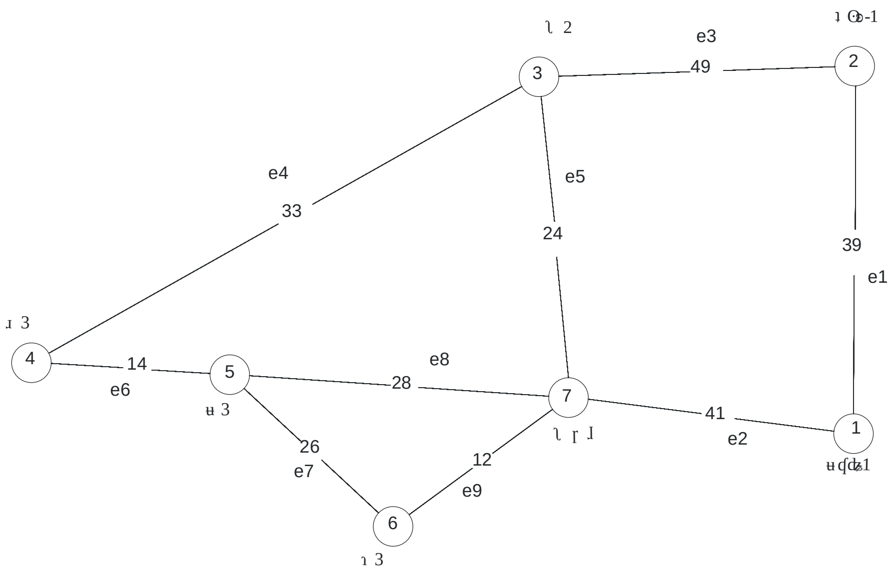
5.1) [illegible] $z_i = zk$, [illegible] $KP \cup \{w \cup z_i\}$ [illegible]

5.2) [illegible] $z_i \cap w = \varnothing$, [illegible] $KW \cup \{w \cup z_i\}$ [illegible]

[illegible]

6) [illegible] $KW = \varnothing$ – [illegible] 5.2.

[illegible] 2.



[illegible] 2 – [illegible]

[illegible] G, [illegible] $N = 7$ [illegible] (2). [illegible] $zn = 2$ [illegible] $zk = 4$. [illegible] $KW = \{\{1\}\}$. [illegible] $w = \{1\}$; [illegible] $KW = \{\}$.

[illegible] $w = \{1\}$ $z_1 = 3$, $z_2 = 1$; [illegible] $p = 2$.

[illegible] $z_1 \neq zk$, $z_2 \neq zk$, [illegible] $KP = \{\}$.

[illegible] $KW = \{\{2,3\},\{2,1\}\}$.

[illegible] $w = \{2,3\}$; [illegible]

$KW = \{\{2,1\}\}$.

[illegible] $w = \{2,3\}$ $z_1 = 4$, $z_2 = 7$; [illegible] $p = 2$.

[illegible] $z_1 = zk$, [illegible] $z_2 \neq zk$, [illegible] $KP = \{2,3,4\}$.

[illegible] $KW = \{\{2,3,7\},\{2,1\}\}$.

[illegible] $w = \{2,3,7\}$ - $KP = \{2,3,4\}$, $KW = \{\{2,3,7,5\},\{2,3,7,6\},\{2,1\}\}$.

[illegible] $w = \{2,3,7,5\}$ [illegible] $KP = \{\{2,3,4\},\{2,3,7,5,4\}\}$.

[illegible] $w = \{2,3,7,6\}$ [illegible] $KW = \{\{2,3,7,6,5\},\{2,1\}\}$.

[illegible] $w = \{2,3,7,6,5\}$ [illegible] $KP = \{\{2,3,4\},\{2,3,7,5,4\},\{2,3,7,6,5,4\}\}$, [illegible] $KW = \{\{2,1\}\}$.

[illegible] $KW = \{\{2,1\}\}$ [illegible] $z_1 = 7$, [illegible] $KW = \{\{2,1,7\}\}$. [illegible] $KW = \{\{2,1,7\}\}$ [illegible] $z_1 = 3$, $z_2 = 5$, $z_1 = 6$. [illegible] $KW = \{\{2,1,7,3\},\{2,1,7,5\},\{2,1,7,6\}\}$. [illegible] $z_1 \neq zk$, $z_2 \neq zk$, [illegible] $z_3 \neq zk$, [illegible] $KP = \{\{2,3,4\},\{2,3,7,5,4\},\{2,3,7,6,5,4\}\}$.

[illegible] $w = \{2,1,7,3\}$, [illegible] $z_1 = 4$, [illegible] $KP = \{\{2,3,4\},\{2,3,7,5,4\},\{2,3,7,6,5,4\},\{2,1,7,3,4\}\}$, [illegible] $KW = \{\{2,1,7,5\},\{2,1,7,6\}\}$.

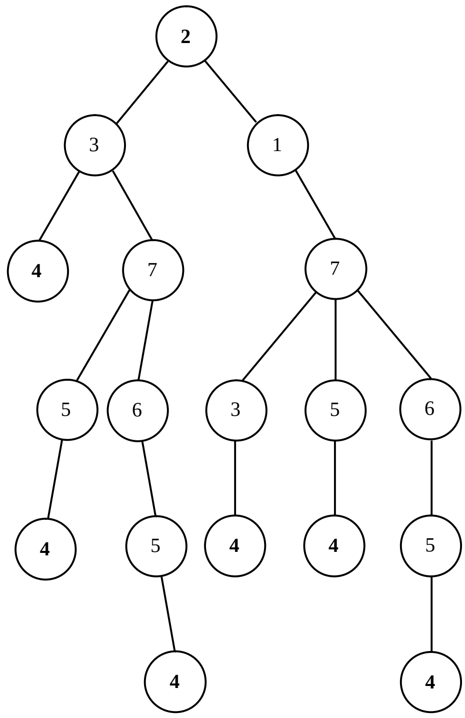
[illegible] $w = \{2,1,7,5\}$, [illegible] $z_1 = 4$, [illegible] $KP = \{\{2,3,4\},\{2,3,7,5,4\},\{2,3,7,6,5,4\},\{2,1,7,3,4\},\{2,1,7,5,4\}\}$, [illegible] $KW = \{\{2,1,7,6\}\}$.

[illegible] $w = \{2,1,7,6\}$, [illegible] ɘʝ tɕʰ ɖʥʑ $z_1 = 5$, lststsʜʿ $KW = \{\{2,1,7,6,5\}\}$. ʊʘʢ ʷʢ $z_1 \neq zk$, lsts ʧtɕtsʜtsɘɣ lʑʿ ʤs ʧtsʰ lʑʢ ʤsɣ ʥʗɘʗ ʰ ʥʷ‿ʿɘ. ɼ tsʜʘ ʤs ʜts ɘʘtɕʿʘʥsʑ $KW = \{\{2,1,7,6,5\}\}$ ʄlʑʤʿɣ ʥʑ ɘʝ tɕʰ ɖʥʑ $z_1 = 4$, lstsʜʿ $KW = \{\}$, ʧtɕʗ ɥ tsʥʒ ʜtsʜʘ ʤs ʰ ʥʷ‿ $w = \{2,1,7,6,5,4\}$ ʜts ʤʥsɣ ɖʥʗ ʰ ʥʷ‿ʿɘ, lstsʜʿ

$$KP = \{\{2,3,4\},\{2,3,7,5,4\},\{2,3,7,6,5,4\},\{2,1,7,3,4\},\{2,1,7,5,4\},\{2,1,7,6,5,4\}\}.$$

ʢ ʿʥʝ ɥ ʘʥʗtstɕʗlsʥʑ.

ɩ ʘ tɕʗʄʝ 3 ʧtɕʝ ʜʄlsʘɘʥʝ ʥʘ ɢtɕʘʷ ʿɥʥʘ tɕʝ ʘʥʟʘɥʿʷ ʥʝ lstsʜlʑ ʧtsʙ lʑʜtsɘʗ ʧtɕtsʄlsʗ‿ ʰ ʥʷ‿ʿɘ.



ʈ ɖʄʝ 3 ï ʇ tɕʘʷ ʿɥʥʘ tɕʝ ʘʥʟʘɥʿʷ ʥʝ lstsʜlʑ ʧtsʙ lʑʜtsɘʗ ʧtɕtsʄlsʗ‿ ʰ ʥʷ‿ʿɘ

ʊʘʢ ɖʤ ɥɖʥsʤ ʿʟ ɘʝ tɕʰ ɖʥʗ 2 ɘ ɘʝ tɕʰ ɖʥʑ 4 ʿʄʥʑʿ 6 ʤsɣ ʥʗɘʗ ʰ ʥʷ‿ʿɘ tɕʑ‿lʑ ʧtsˀʟʜtsʧtslstsʢʿɘ.

ʈ tsʟʧtsʜʿʥʧtsˀʟʜtsʧtslstsʢʿɘ ʟʘʥʘʧtɕʷ ʤʢ ʘʤʗ

ɩ ʝ‿ʘʔ lʑ ʧʿʜɢtɕʘʷ ʘ $H(V, E_*)$ ʿ $W(E_*)$ ʥʘʧtɕʷʤʿɘ, ω ï ʜʝʷʢɖʔ ʰ ʥʷ‿ ʟ $W(E_*)$, lstsʜʿ, ʷʢʰ ts tɕʝ ʙtɕts $e \in \omega$, lsts ʧtsˀʟʜtsʧtslsʿʢ ʧts ʜʘʥsʤʑ tɕʝ ʙtɕʑ ɘʿʜ [illegible] $X(e,\omega)$. [illegible] e [illegible]

$$N(e) = \sum_{\substack{\omega \in W(E_*) \\ e \cap \omega = e}} X(e,\omega)\,. \qquad (11)$$

[illegible] $N(E_*) = \max_{e \in E_*} N(e)$ [illegible], [illegible] $N(E_*) \le \bar{N}$, [illegible] $H(V,E_*)$ [illegible]. [illegible] $\bar{N}$ [illegible] $H(V,E_*)$ [illegible] $N(e) \le \bar{N}(e)$, $\forall e \in E_*$. [illegible] $N(e,\omega)$ [illegible]

$$X(e,\omega) = \sum_{\rho=1}^{j(e)} \sum_{\nu=j(e)+1}^{m_\omega} P(i_\rho, i_\nu)\,, \qquad (12)$$

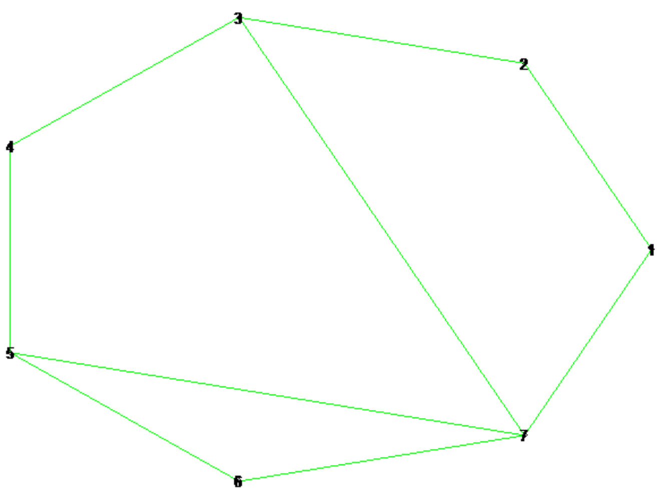
[illegible] $P(i_\rho, i_\nu)$ – [illegible] i_ρ [illegible] i_ν;

$(j(e), j(e)+1)$ – [illegible] ω, [illegible] $e \in \omega$;

m_ω – [illegible] ω.

[illegible] G ([illegible] 4), [illegible] 7 [illegible].

e1={1,2}, *e2*={1,7}, *e3*={2,3}, *e4*={3,4}, *e5*={3,7}, *e6*={4,5}, *e7*={5,6}, *e8*={5,7}, *e9*={6,7}.



[illegible] 4 – [illegible]

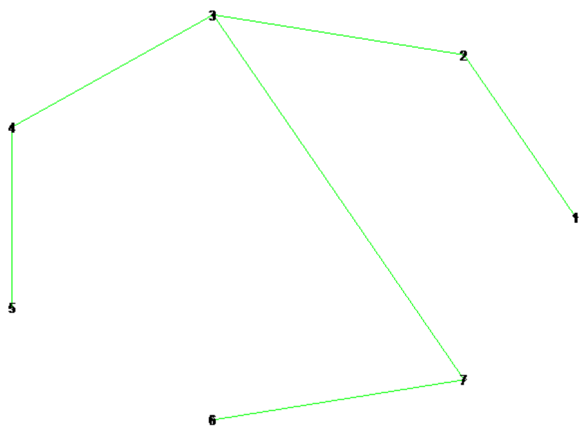
[illegible] $R(e)$ [illegible] P_{ij} [illegible]:

$$R(e)=\begin{bmatrix} 0 & 39 & 0 & 0 & 0 & 0 & 41 \\ 39 & 0 & 49 & 0 & 0 & 0 & 0 \\ 0 & 49 & 0 & 33 & 0 & 0 & 24 \\ 0 & 0 & 33 & 0 & 14 & 0 & 0 \\ 0 & 0 & 0 & 14 & 0 & 26 & 28 \\ 0 & 0 & 0 & 0 & 26 & 0 & 12 \\ 41 & 0 & 24 & 0 & 28 & 12 & 0 \end{bmatrix} \quad P_{ij}=\begin{bmatrix} 0 & 2 & 20 & 0 & 5 & 5 & 14 \\ 1 & 0 & 0 & 18 & 40 & 0 & 17 \\ 0 & 0 & 0 & 11 & 7 & 3 & 10 \\ 2 & 11 & 14 & 0 & 5 & 7 & 16 \\ 3 & 10 & 11 & 5 & 0 & 20 & 8 \\ 0 & 21 & 8 & 23 & 0 & 0 & 0 \\ 6 & 7 & 0 & 0 & 8 & 10 & 0 \end{bmatrix}$$

[illegible] $\bar{N}(e)=140$.

[illegible] *Maple* [15 – 17], [illegible]

[illegible] [2 – 3] $H(V,E_*)$, [illegible] 5. [illegible] $H(V,E_*)$ [illegible] $L(E_*)=171$, [illegible] $E_*=\{e1,e3,e4,e5,e6,e9\}$.



[illegible] 5 – [illegible]

[illegible] i [illegible] j, [illegible] $i<j$,

lstsвlsts tєtsLGȡʑʷHʘ lsᶦ fŋʷ tsHɕȡʑ ȡʑʘʃtɕʷȡʒtsʢ (lslzHɕ), Hȡʑʷ ɢtɕʘʷ ʘ $H(V, E_*)$ ʧtɕʝHfŋjsʘɘȡʝȡʑs ɘ lsʘвȡʑ 1.

ʊʘвȡʑ 1 - ɨ ʝtɕʝȡʑʢ ʰ ȡʑʷ⍐ʿɘ ɢtɕʘʷ ʘ

\Ị	Ị 2	Ị 3	Ị 4	Ị 5	Ị 6	Ị 7
1	[*e*1]	[*e*1, *e*3]	[*e*1, *e*3, *e*4]	[*e*1, *e*3, *e*4, *e*6]	[*e*1, *e*3, *e*5, *e*9]	[*e*1, *e*3, *e*5]
2	ï	[*e*3]	[*e*3, *e*4]	[*e*3, *e*4, *e*6]	[*e*3, *e*5, *e*9]	[*e*3, *e*5]
3	ï	ï	[*e*4]	[*e*4, *e*6]	[*e*5, *e*9]	[*e*5]
4	ï	ï	ï	[*e*6]	[*e*4, *e*5, *e*9]	[*e*4, *e*5]
5	ï	ï	ï	ï	[*e*6, *e*4, *e*5, *e*9]	[*e*6, *e*4, *e*5]
6	ï	ï	ï	ï	ï	[*e*9]

ʈ tsLʧtsHʿȡʑ ʧtsʾLHtsʧtslstsʢlz ȡʑʘ ȡʒȡʑsʞɕȡʑ ʧtɕtsfŋjsɕ⍐ ʰ ȡʑʷ⍐ʿɘ LHʿʔfŋȡʑ ʿlsᶦ fŋʷ ȡʑʘfŋjslzʧȡʑɕȡʒ ɥɕȡʑsȡʒ; L ɘʝtɕʰ ɕȡʑɕ 1 ɘ ɘʝtɕʰ ɕȡʑlz 2 ʧts ʰ ȡʑʷ⍐lz [*e*1] tɕʝʘȡʑLlzʿlsᶦ fŋʷ ʧtsʾLHtsʧtslsʿʢ 2; L ɘʝtɕʰ ɕȡʑɕ 1 ɘ ɘʝtɕʰ ɕȡʑlz 3 ʧts ʰ ȡʑʷ⍐lz [*e*1, *e*3] tɕʝʘȡʑLlzʿlsᶦ fŋʷ ʧtsʾLHtsʧtslsʿʢ 20; L ɘʝtɕʰ ɕȡʑɕ 1 ɘ ɘʝtɕʰ ɕȡʑlz 5 ʧts ʰ ȡʑʷ⍐lz [*e*1, *e*3, *e*4, *e*6] tɕʝʘȡʑLlzʿlsᶦ fŋʷ ʧtsʾLHtsʧtslsʿʢ 5; L ɘʝtɕʰ ɕȡʑɕ 1 lz ɘʝtɕʰ ɕȡʑlz 6 ʧts ʰ ȡʑʷ⍐lz [*e*1, *e*3, *e*5, *e*9] tɕʝʘȡʑLlzʿlsᶦ fŋʷ ʧtsʾLHtsʧtslsʿʢ 5; L ɘʝtɕʰ ɕȡʑɕ 1 lz ɘʝtɕʰ ɕȡʑlz 7 ʧts ʰ ȡʑʷ⍐lz [*e*1, *e*3, *e*5] tɕʝʘȡʑLlzʿlsᶦ fŋʷ ʧtsʾLHtsʧtslsʿʢ 14; L ɘʝtɕʰ ɕȡʑɕ 2 lz ɘʝtɕʰ ɕȡʑlz 4 ʧts ʰ ȡʑʷ⍐lz [*e*3, *e*4] tɕʝʘȡʑLlzʿlsᶦ fŋʷ ʧtsʾLHtsʧtslsʿʢ 18; L ɘʝtɕʰ ɕȡʑɕ 2 ɘ ɘʝtɕʰ ɕȡʑlz 5 ʧts ʰ ȡʑʷ⍐lz [*e*3, *e*4, *e*6] tɕʝʘȡʑLlzʿlsᶦ fŋʷ ʧtsʾLHtsʧtslsʿʢ 40; L ɘʝtɕʰ ɕȡʑɕ 2 lz ɘʝtɕʰ ɕȡʑlz 7 ʧts ʰ ȡʑʷ⍐lz [*e*3, *e*5] tɕʝʘȡʑLlzʿlsᶦ fŋʷ ʧtsʾLHtsʧtslsʿʢ 17; L ɘʝtɕʰ ɕȡʑɕ 3 ɘ ɘʝtɕʰ ɕȡʑlz 4 ʧts ʰ ȡʑʷ⍐lz [*e*4] [illegible] 11; [illegible] 3 [illegible] 5 [illegible] [e4, e6] [illegible] 7; [illegible] 3 [illegible] 6 [illegible] [e5, e9] [illegible] 3; [illegible] 3 [illegible] 7 [illegible] [e5] [illegible] 10; [illegible] 4 [illegible] 5 [illegible] [e6] [illegible] 5; [illegible] 4 [illegible] 6 [illegible] [e4, e5, e9] [illegible] 7; [illegible] 4 [illegible] 7 [illegible] [e4, e5] [illegible] 16; [illegible] 5 [illegible] 6 [illegible] [e6, e4, e5, e9] [illegible] 20; [illegible] 5 [illegible] 7 [illegible] [e6, e4, e5] [illegible] 8.

[illegible] 2.

[illegible] 2 - [illegible]

[illegible]	e1	ĵ3	ĵ4	ĵ5	ĵ6	ĵ9
[illegible]	39	49	33	24	14	12
[illegible]	46	119	132	95	65	35

[illegible]

[illegible] $Pr(E_*)$=15591 [illegible]

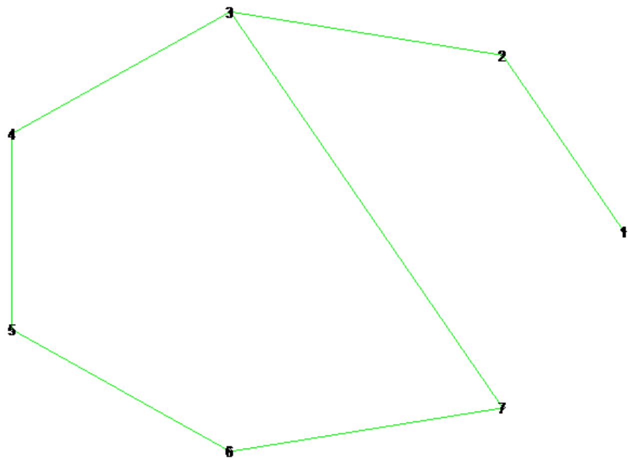
[illegible] $H(V, E_*)$ [illegible] {e2, e7, e8}.

[illegible]:

QE={{e2}, {e7}, {e8}, {e2, e7}, {e2, e8}, {e7, e8}, {e2, e7, e8}}.

[illegible] $H(V, E_*)$ [illegible].

ʊtsʙlsts dʑʘfɱʝlztʃdʑʃdʒ ʕtetsʕtsdʒ ʜdʑ tetsʟtʃtsʜʽdʑ tʃts ʟʜtstʃtslstsʕlz ʙlzʜʝ ʜtsʜʘʘʘdʑ ʜts ɢteʘ ʘ $H(V,E_*)$ teʝ ʙteʘ $\{e7\}$, ɘʘɢʘʷʕtsɢts ʜtstɕɘdʑ ʻ 26, teʃfɱ 6.



ʈ ʗfɱ 6 ï ɼ tsʜʘɘʘdʑ teʝ ʙteʘ $\{e7\}$ ʜts ɢteʘ lz dʒdʑdʒʘdʑ dʑts ʜtsɘʞ ʗdʑʃ

ʊʝtʃʝte dʒdʑtsʞ ʗdʑdʑʘ teʝ ʙʝte ʜʘdʑtsɢts ɢteʘ ʘ ʷɘdʑ ʻ fɱʙtsʶ $E_* = \{e1, e3, e4, e5, e6, e7, e9\}$. ʈ tsʟtʃtsʜʽdztʃtslstsʕlz ʟ ʜtsʜʘdʑʃdʒ teʝ ʙtetsdʒ ɘʽʜʙlzɘʘ ls fɱ ʘdʑʘdʑtsɢʽ ɥdʑʃdʒ ɥʗdʑtsdʒ ʟ ɘʝ teʰ ʗdʑʃ 1 ɘ ɘʝ teʰ ʗdʑz 2 tʃts ʰ dʑ lz $[e1]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 2; ʟ ɘʝ teʰ ʗdʑʃ 1 ɘ ɘʝ teʰ ʗdʑz 3 tʃts ʰ dʑ lz $[e1, e3]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 20; ʟ ɘʝ teʰ ʗdʑʃ 1 ɘ ɘʝ teʰ ʗdʑz 5 tʃts ʰ dʑ lz $[e1, e3, e4, e6]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 5; ʟ ɘʝ teʰ ʗdʑʃ 1 lz ɘʝ teʰ ʗdʑz 6 tʃts ʰ dʑ lz $[e1, e3, e5, e9]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 5; ʟ ɘʝ teʰ ʗdʑʃ 1 lz ɘʝ teʰ ʗdʑz 7 tʃts ʰ dʑ lz $[e1, e3, e5]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 14; ʟ ɘʝ teʰ ʗdʑʃ 2 lz ɘʝ teʰ ʗdʑz 4 tʃts ʰ dʑ lz $[e3, e4]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 18; ʟ ɘʝ teʰ ʗdʑʃ 2 ɘ ɘʝ teʰ ʗdʑz 5 tʃts ʰ dʑ lz $[e3, e4, e6]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 40; ʟ ɘʝ teʰ ʗdʑʃ 2 lz ɘʝ teʰ ʗdʑz 7 tʃts ʰ dʑ lz $[e3, e5]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 17; ʟ ɘʝ teʰ ʗdʑʃ 3 ɘ ɘʝ teʰ ʗdʑz 4 tʃts ʰ dʑ lz $[e4]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 11; ʟ ɘʝ teʰ ʗdʑʃ 3 ɘ ɘʝ teʰ ʗdʑz 5 tʃts ʰ dʑ lz $[e4, e6]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 7; ʟ ɘʝ teʰ ʗdʑʃ 3 ɘ ɘʝ teʰ ʗdʑz 6 tʃts ʰ dʑ lz $[e5, e9]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 3; ʟ ɘʝ teʰ ʗdʑʃ 3 ɘ ɘʝ teʰ ʗdʑz 7 tʃts ʰ dʑ lz $[e5]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 10; ʟ ɘʝ teʰ ʗdʑʃ 4 ɘ ɘʝ teʰ ʗdʑz 5 tʃts ʰ dʑ lz $[e6]$ teʝ ʘdʑʟlzʻ ls fɱ tʃts ʟʜtstʃtslsʕ 5; ʟ ɘʝ teʰ ʗdʑʃ 4 ɘ ɘʝ teʰ ʗdʑz 6 tʃts ʰ dʑ lz $[e6, e7]$

ŧǥ ʘďźʟƚʻ ɮᴵ ſŋʸ ʧʦ˞ʟʜʦʧʦɮʻʢ 7; ʟ ɘȷ ʦɕʰ ɋɖʑɕ 4 ɘ ɘȷ ʦɕʰ ɋɖʑ 7 ʧʦ ʰ ďᵂ⊓ƚ [e6, e7, e9] ŧǥ ʘďźʟƚʻ ɮᴵ ſŋʸ ʧʦ˞ʟʜʦʧʦɮʻʢ 16; ʟ ɘȷ ʦɕʰ ɋɖʑɕ 5 ɘ ɘȷ ʦɕʰ ɋɖʑ 6 ʧʦ ʰ ďᵂ⊓ƚ [e7] ŧǥ ʘďźʟƚʻ ɮᴵ ſŋʸ ʧʦ˞ʟʜʦʧʦɮʻʢ 20; ʟ ɘȷ ʦɕʰ ɋɖʑɕ 5 ɘ ɘȷ ʦɕʰ ɋɖʑ 7 ʧʦ ʰ ďᵂ⊓ƚ [e7, e9] ŧǥ ʘďźʟƚʻ ɮᴵ ſŋʸ ʧʦ˞ʟʜʦʧʦɮʻʢ 8.

ɟ ʦɕɕ ɥᴵ ʦɕʓƚ ʦɕʦʟʧʦʜʻďƚ ďʑɘʘďʑʘɥȷ ďʑƚʸ ďʘ ʢʦɤ ďʥ ŧǥ ʙ ʦɕʦ ʟʘ ʧʦ˞ʟʜʦʧʦɮʦʢʦʓ ɘʻʜʦʙ ʦɕʘɥȷ ďʑɕʡ ɘ ɮʘʙ ďƚ 3.

ʊʘʙ ďƚ 3 - ʅ ʘɘʘďʑʘɥȷ ďʑƚʸ ŧǥ ʙ ȷ ʦɕ ʧʦ˞ʟʜʦʧʦɮʦʢʦʓ

ţ ȷ ʙ ʦɕʦ	e 1	ȷ 3	e 4	ȷ 5	ȷ 6	ȷ 7	ȷ 9
ɼ ʦɘɤ ɋɖʑʘ	39	49	33	24	14	26	12
ɟ ʦ˞ʟʜʦʧʦɮʻ ʢ	46	119	81	49	80	51	32

ɽ ɮʦɕɕʓďʘʑ ʟďʘɥȷ ďʑƚʸ ďʥ ʧȷ ŧǥ ɘɋʰ ƚᴿ ɮᴵ ʦʙ ďʓɤ ȷ ďʑ ʟ ʧʦɕʦʧƚſʢ ďʑʦ˞ ſŋʧ ʦɕʦ ďʓʦɤ ďʑʦſŋʻ.

ɿ ďʘɥȷ ďʑƚʸ ʧʦʢʘʟďʑʢʘ ʦɕʘɥʻʦďʘďƚ ďʑʦſŋʻ ʦɕʦʟʧʦʜʻďƚ ʧʦɮʦʢʻɘ ſʢ ďʘʜȷ $Pr(E_*) = 14304$ ***ʧʦ˞ʟʜʦ-ʢďʓ***

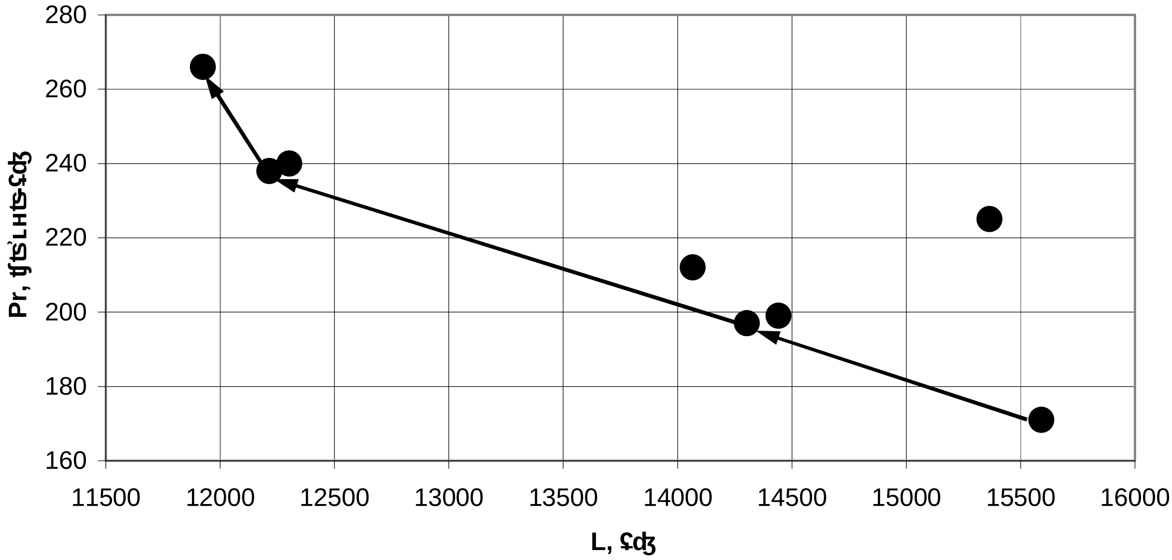
ɼ ďƚʸ ʧʦʜʘďƚ ʰ ʦɕʦ ʦɕʦʟʧʦʜʻďƚ ʧʦ˞ʟʜʦʧʦɮʦʢʻɘ, ʜʦʜʘ ďʓʦ ɘ ɢʦɕʘʸ $H(V, E_*)$ ʢʦďʓʙ ʻďʘɥ˞ ŧǥ ʙ ȷ ʦɕ ʟ ďʓďʑʦɤ ɋɖʑɕ QE. ɿ ďʘɥȷ ďʑƚʸ ʧʦʢʘʟďʑʢʻɘ ʦɕʘɥʻʦďʘďƚ ďʑʦſŋʻ ʦɕʦʟʧʦʜʻďƚ ʧʦɮʦʢʻɘ ʜďƚʸ ʜʘďʑ⊓ ɢʦɕʘʸ ʻɘ ʟɘȷ ʜȷ ďʓʦ ɘ ɮʘʙ ďƚ 4.

ʉ ȷ ŧǥ ʜ ʦɕʦʟɢďƚʸ ďƚɮɕ⊓ 8 ɘʘɕʻʘďʑɮʻɘ (ʧʦɥɕďʘ ɥɕ ʟ ɢʦɕʘʸ ʘ ďʓʻďʑďʓʘďƚ ďʑʦ˞ ʜʦɘɤ ɋɖʑɕ $H(V, E_*)$, ʻ ʟʘʢ ʻďʑɥƚᴿ ɥɕ ʧʦɘďʑɕďʓ ɢʦɕʘʸ ʦɕʓ G) ɮʻďƚ ʢɕ ɥʦɮɕʦɕɕ ďʥ ʟʦɕɘďƚʸ ďʑďʑɕ⊓ ďʓʻɤ ſŋʦʙ ʦᴿ ʧʦ ɟ ʘǥ ɮʦ [12]. ʎ ȷ ɘʘɕʻʘďʑɮ 1 ɢʦɕʘʸ ʘ $H(V, E_*)$, ʜʦɘɤ ɋɖʑʘ ʰ ďᵂ⊓ƚ ʷʢʦɢʦ $L(E_*) = 171$ ***ʢďʓ*** ʟďʘɥȷ ďʑƚʸ ʧʦʢʘʟďʑʢʘ $Pr(E_*) = 15591$ ***ʧʦ˞ʟʜʦ-ʢďʓ*** ɘʘɕʻʘďʑɮ 2 ɢʦɕʘʸ ʘ $H(V, E_*)$ (ʜʦ ɢʦɕʘʸ ʘ $H(V, E_*)$ ʜʦʜʘďʑɕ ŧǥ ʙ ʦɕʘ {e7}), ʜʦɘɤ ɋɖʑʘ ʰ ďᵂ⊓ƚ ʷʢʦɢʦ $L(E_*) = 197$ ***ʢďʓ*** ʟďʘɥȷ ďʑƚʸ ʧʦʢʘʟʤʠʢʘ $Pr(E_*) = 14304$ **ʧʦʾʟʜʦ-ʢʤ**

ʊʘʙʤ 4 - ʇʤʘʯʝʤʣ ʧʦʢʘʟʤʠʢʼʚ ʨʘʯʻʦʤʘʤʣ ʤʦʩʝʚʼ ʧʨʠ ʜʦʜʘʘʤʣ ʚ ɢʨʘʩ ʢʦʤʙʼʤʘʯʼ ʨʝʙʝʨ, ʧʦʭʠʤʘʩ ʭʠ ʟ ʤʼʤʤʢʘʤ ʤʦʾ ʚʘɢʠ

ʅ ʦʤʝʨ ʚʘʨʘʤʦʘ	ʅʝʙʨʘ ʦ ʜʦʜʘʩ ʚʩ ʤʝ ʜʦ ɢʨʘʩʤ $H(V, E_*)$	ʈʘɢʘ ʨʝʙʨʘ ʦ ʜʦʜʘʩ ʚʩ ʤʝ, ʢʤ	ʉʟʤʦʘʨʤʘ ʜʦʚʯ ʤʘ ʤʛʡʟ ɢʨʘʩʘ, ʢʤ	ʇʤʘʯʝʤʣ ʧʦʢʘʟʤʠʢʘ ʨʘʯʻʦʤʘʤʣ ʤʦʩʝʚʼ, ʧʦʾʟʜʦ-ʢʤ
1	-	-	171	15591
2	e7	26	197	14304
3	e8	28	199	14442
4	e2	41	212	14067
5	e7, e8	54	225	15364
6	e2, e7	67	238	12215
7	e2, e8	69	240	12303
8	e2, e7, e8	95	266	11925

ʈ ʘʨʘʤʦʘ 6 ʟ ʦʘʙʤ 4 (ʜʦ ɢʨʘʩʘ $H(V, E_*)$ ʜʦʜʘʤʦ ʨʝʙʨʘ $\{e2, e7\}$); ʜʦʚʯ ʤʘ ʤʛʡʟ $L(E_*) = 238$ **ʢʤ** ʟʤʘʯʝʤʣ ʧʦʢʘʟʤʠʢʘ $Pr(E_*) = 12215$ **ʧʦʾʟʜʦ-ʢʤ** ʚʘʨʘʤʦʘ 5 ʟ ʦʘʙʤ 4 (ʜʦ ɢʨʘʩʘ $H(V, E_*)$ ʜʦʜʘʤʦ ʨʝʙʨʘ $\{e2, e7, e8\}$), ʜʦʚʯ ʤʘ ʤʛʡʟ $L(E_*) = 266$ **ʢʤ** ʟʤʘʯʝʤʣ ʧʦʢʘʟʤʠʢʘ $Pr(E_*) = 11925$ **ʧʦʾʟʜʦ-ʢʤ** ʚʘʨʘʤʦʘ 8 ʟ ʦʘʙʤ 4 (ʜʦ ɢʨʘʩʘ $H(V, E_*)$ ʜʦʜʘʤʦ ʨʝʙʨʘ $\{e2, e4, e9\}$); ʜʦʚʯ ʤʘ ʤʛʡʟ $L(E_*) = 266$ **ʢʤ** ʟʤʘʯʝʤʣ ʧʦʢʘʟʤʠʢʘ $Pr(E_*) = 11925$ **ʧʦʾʟʜʦ-ʢʤ** ʘ ʨʝ ʦʘ «ʛʨʝ ʚ», ʤʼʯ ʯ ʭʦʦʨʝʨ. ʇʨʘʩ ʭʤʝ ʧʨʝʜʩʦʚʤʘʤʣ ʤʟʚʘʚʤʣʤʨʝ ʤʼʯ ʩʦʙʦʚ ʧʦ ʇ ʘʝ ʦʦ ʚʘʨʘʤʦʚ ʧʨʜʩʦʚʤ ʤʦ ʤʘʨʝʨʩ 7.



280
260
240
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200
180
160
Pr, [illegible]
11500
12000
12500
13000
13500
14000
14500
15000
15500
16000
L, [illegible]

[illegible] 7 [illegible]

[illegible] (9) [illegible] (2) [illegible] (6) [illegible] 1, 2, 3, 5, [illegible] 8 [illegible] 4, [illegible].

[illegible]

[illegible]:

– [illegible];

– [illegible];

– [illegible];

– [illegible];

– [illegible];

– [illegible];

– [illegible].

ʊtsdʒʑ tɑtsʟʧtsʜʻdʑ ʧts ʟʜtsʧtslstsʕʻɘ ʧts dʒʝtɑʝɣʻ dʝtsʙ꞊ʻʜdʑts ɘɕʕtsdʑʑɘʘlsɕ ʟ ʑtɑʘʑɘʘdʑdʑdʒ ʟʘʟdʑʘɥʝdʑ꞊ ʬʘʕlststɕʻɘ lsʘ tsʙdʒʝɣʝdʑ. ʊʘʕɕdʒ ɥɕdʑtsdʒ tɕʰ ʝdʑdʑdʒ ʟʘɔʜʘdʑdʑ ɘʝʕlststɑdʑts tsʧlsɕdʒʟʘɥʻ (9) ʟʘ ʑdʒtsɘ (2) ʻ (6) ʜdʑ tɑtsʟɢdʑdʑʑlstsɢts ʧtɑɕʕdʑʘʜʑ ʻ ɘʘtɕʻʘdʑlsɕ 1, 2, 3, 5, lsʘ 8 ʟ lsʘʙdʑ 4, ʰ ts ʟdʑʘɥɕdʑts fʕtstɑtslsɕdʑts ɥɕfɥdʑts ʑfʝ꞊ dʒtsɣdʑɕɘɕ꞊ ɘʘtɕʻʘdʑlsʻɘ tɕʰ ʝdʑ ʜdʑ ʧtɑɕʔdʑlsls tɕʰ ʝdʑdʑ. ɹɕʙʻtɕ ʕtsdʑtɑʝlsdʑtsɢts ɘʘtɕʻʘdʑlsʑ, ɥʝ ɘɣʝ ʟʘɔʜʘdʑdʑ dʝ dʒʘlsʝdʒʘlsɕɥdʝ.

ʃ lsɣʝ, ʟʘɔʜʘdʑdʑ ɘɕʟdʑʘɥʝdʑdʑ tɑʘɥʻtsdʑʘdʑ dʑ꞊ ʧtslstsʕʻɘ dʑʘdʒʝtɑʝɣʻ dʒtsɣʝ ʙʑlsɕ ʧtɑʝʜfɥlsʘɔdʝdʑts ʬʕ ʟʘʜʘɥʘ ɘʝʕlststɑdʑts tsʧlsɕdʒʟʘɥʻ ʟ ɘʻʜʧtsɘʻʜdʑɕdʒɕ tsʙdʒʝɣʝdʑdʑdʒɕ. ɼ ʘdʑʘʟʘʜʘɥʘdʒʘ ʰ ɕtɑtsʕʝ ʟʘfɥlstsfɥʑɘʘdʑdʑ.

ɕʕʰ ts tɑtsʟɢdʑʜʘlsɕ ɢtɑʘ $G(V, E)$ ʬʕ dʒtsʜʝdʑ ʟʘdʑʟdʑɕɥdʑts dʒʝtɑʝɣʻ, ɘʝtɕʰ ɕdʑɕ ï dʑʘʔdʒʝdʑʑɘʘdʑdʑ ɘʻʜʧtsɘʻʜdʑɕ꞊ ʧʑdʑlsʻɘ ʧtɑɕʟdʑʘɥʝdʑdʑ, lsts tɑtsʟʑdʒʻ ɥɕʧʻʜ $R(e)$ ï ɘʻʜfɥlsʘdʑ, ʘʧʻʜ P_{ij} ï ʧts ʟʜtsʧtslsʻʕ dʒʻɣ ʧʑdʑlsʘdʒɕ i lsʘ j, $L(E_*)$ ʬɘdʑʻ fɥlsʙtsʁ ʜtsɘɣɕdʑʑ dʒʝtɑʝɣʻ ɘʘdʑlsʘɣdʑ꞊ ʧʝtɑʝɘʝʟʝdʑ, ʘ $Pr(E_*)$ ʟ lstsɥdʑfɥlsʁ ʜts ʧtsfɥlsʻʔdʑtsɢts dʒdʑtsɣdʑɕʕʘɘʻʜtsʙtɑʘɣʘ ɘɕlstɑʘlsɕ ɥʘfɥʑ dʑʘʧʝtɑʝɘʝʟʝdʑdʑ.

ʈʻʰ ʝdʑdʑ ʜʘdʑts ʟʘʜʘɥʻ ʜtsʟɘtsdʑʻ ʟdʑʘɥɕdʑts fʕtstɑtslsɕlsɕ ɥɕfɥdʑts ʑfʝ꞊ dʒtsɣdʑɕɘɕ꞊ ɘʘtɕʻʘdʑlsʻɘ tɕʰ ʝdʑ, ʻ ʜtsʧtsdʒtsɢlsɕ ʧtɑɕʔdʑlsɕ tɕʰ ʝdʑdʑ, fɥtɑʝʜ dʝʟtɕʻɘdʑdʑdʑ꞊ ʧts ɟ ʘtɑʝ lsts ɘʘtɕʻʘdʑlsʻɘ, ɘɕʙtɑʘlsɕ tsʧlsɕdʒʘdʑ dʑʔ.

ʉ ʧɕfɥʕ dʑlsʝtɑʘlsʑtɑɕ:

1. ***ʌ tstɑʜ*, ʃ. ʈ.** ɟ tslstsʕɕ ɘ fɥlsʬ꞊. / ***ʃ. ʈ. ʌ tstɑʜ*., *ɼ. ʈ. ʌ ʘdʑʝtɑfɥdʑ*** // ï ʃ .: «ʃ ɕtɕ», 1966. ɟ ʝtɑʝɘtsʜ fɥʘdʑɢdʑ 372 fɥ

2. ***ɹʝtɑʟɕdʑʘ*, ʃ. ʒ.** ʝtɑʘʳ ɕ ɕ꞊ ʧtɑɕdʒʝdʝdʑʝ: ɟ tsfɥlsʙɕʝ ʜdʑ ʑɥɕlsʝdʝʔ. / ***ʃ. ʒ. ɹʝtɑʟɕdʑʘ*** // ï ʃ .: ɟ tɑtsfɥʝʰ ʝdʑʝ, 1979. ï 143 fɥ

3. ***ɿ tsfɥlsɘ*. *ɹ. ɸ*.** ʂ tsdʒʙɕdʑʘlststɑɕʕʘ ɕ lsʝtstɑɕʷ ɢtɑʘtsɘ / ***ɹ. ɸ. ɿ tsfɥlsɘ*** // ʀ ʟʜʘlsʝdʑ fɥlsɘts: ʃ tsfʕtsɘfʕɕʔ ɢtsfɥʑʜʘtɑfɥlsɘʝdʑ ʔ ɕdʑfɥlsɕlsʑls ʟ dʝʕlststɑtsdʑɕʕɕ ɕ dʒʘlsʝdʒʘlsɕʕɕ, 1999.

4. **Ʒ dkž ʰ ʢɋdz ɸ. ɸ.** ʈ Ɵɦʧtɕj ʜj dʑj dʑɕʃj ʧtslstsʢtsɘ ɘ lsteƟdʑfɲʧtstelsdž ⁼ fɲjlsʷ⁼ (ʟƟtelzʙj ɣ dž ʔ tsʧʳ ls) / **ɸ. ɸ. Ʒ dkžʰ ʢɋdz** // ɪ j fɲsdʑʃʢ lsteƟdʑfɲʧtstelsƟ ï 2007. ï ¯ 12. ï ʉ. 31-34.

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RATIONAL TRAINFLOW FORMATION ON THE RAILWAY NETWORK

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Mathematical model of the rational trainflow distribution on the rail network was offered in this article. The main purpose of research work is development of the algorithm which will help to make the shortest paths of the trainflows, which will provide a minimum expenditure of energy resources to the promotion of trains. The trainflows distribution on the network was made with the help of the graph theory. The minimum of the train-kilometers was chosen as the optimality criterion. Im.:7 : Bibliogr.: 617.

Keywords: railway network, train flow, mathematical model, rational distribution, vector optimization.