Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	ENGINEERING ECONOMY
COURSE CODE	:	BDA 40902
PROGRAMME CODE	:	4 BDD
EXAMINATION DATE	:	JANUARY/FEBRUARY 2022
EXAMINATION PERIOD	:	2 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS IN **SECTION A** 2. SELECT **ONE (1)** QUESTION FROM **TWO (2)** QUESTIONS PROVIDED IN **SECTION B** 3. THIS FINAL EXAMINATION IS AN ONLINE ASSESSMENT AND CONDUCTED VIA CLOSE BOOK

THIS QUESTION PAPER CONSISTS OF **TWELVE (12)** PAGES

SECTION A : Answer ALL questions

Q1 (a) One of the importance of engineering economy to engineers is to prepare for concurrent engineering practice. Using appropriate example, describes the concurrent engineering approach

(3 marks)

(b) AVILA Construction Sdn Bhd plans to buy a new truck crane. There are **THREE (3)** alternative brands to be evaluated in terms of cost estimation as shown in **Table Q1(b).** Given the MARR is 18% per annum. Noted that L3D represents the Last Three Digit of student matric number.

Table Q1(b): Manufacturers, lives and costs of three lined slurry pump

COST ITEMS	SANI	SANE	SANU
Capital Investment	RM 49,000 + (1000 x L3D)	RM 84,000 + (1000 x L3D)	RM 28,000 + (1000 x L3D)
Annual Expenses: Maintenance	RM 1,500 per year	RM 1,000 in year 1, and increasing RM 400/yr thereafter	RM 2,000 in year 1, and increasing RM 350/yr thereafter
Useful life (years)	6	8	4
Market Value (Disposal Cost)	RM 10,000	RM 20,000	RM 10,000

(i) Draw cash-flow diagram for each machine.

(6 marks)

(ii) Apply the private project evaluation method to compare the annual worth, AW for each machine.

(12 marks)

(iii) Justify which machine should be selected.

(4 marks)

Q2 (a) Identify each of the following cash flow to indicate whether it is a benefit, a disbenefit, or a cost.

(i) A roadway resurfacing project requires traffic to be diverted onto other roadways.

(1 mark)

(ii) The replacement of equipment that reaches the end of its useful life during the time horizon of the analysis.

(1 mark)

(iii) A tunnel is proposed to be built to save travel time and road construction cost around a mountain.

(1 mark)

(iv) The replacement of equipment that reaches the end of its useful life during the time horizon of the analysis.

(1 mark)

(v) Increase in home operating costs associated with the car such as car insurance payment, fuel to run the car and associated car maintenance.

(1 mark)

(b) The Pahang State Government is plan to provide a project to establish a large flood drainage culvert from the Chalet and RKT Homestay to Tasik Cini. The initial cost spent is RM 2,000,000 for the job and the cost and benefit items are shown in **Table Q2(b)**. The MARR is 6% per year, and the project's life is 30 years. Evaluate this project based on;

Table Q2(b): Cost and Benefit

Cost and Benefit Items	RM
Right of way maintenance	30,000 per year
Major upkeep every six years, starting at the present time	50,000
Annual benefit to the taxpayers	135,000

(i) Conventional PW B/C ratio

(14 marks)

(ii) Conventional AW B/C ratio

(6 marks)

Q3 (a) For equipment that has a first cost of RM 10,000 and the estimated operating costs and year-end salvage values shown in **Table Q3(a)** below, determine the economic service life at i = 10% per year.

Table Q3(a)

Year	Operating Cost, RM per Year	Salvage Value, RM
1	-1,000	7,000
2	-1,200	5,000
3	-1,300	4,500
4	-2,000	3,000
5	-3,000	2,000

(10 marks)

(b) A furniture company intends to evaluate whether they want to stick with the existing equipment (defender) or replace them with the new productive equipment (challenger). The details of the cost required are shown in **Table Q3(b)** below. Use an interest rate of 20% per year.

Table Q3(b)

Items	Defender	Challenger
Initial cost eight (8) years ago (RM)	450,000	-
Market value (RM)	25,000	700,000
Yearly handling cost (RM)	160,000	70,000
Life time (year)	5	10
Salvage value (RM)	0	50,000

(i) Use the replacement analysis to justify whether the existing equipment is required to be replaced with the new equipment.

(10 marks)

(ii) If the existing equipment (defender) could be sold in international market, determine how much is the minimum value of the defender so that the challenger could replace the defender now?

(5 marks)

SECTION B : Answer ONE question only

Q4 (a) Identify each of the following cash items whether it is fixed cost, variable cost, sunk cost, or opportunity cost.

(i) Company A invests RM 5,000,000 over a five-year period to research and develop a new pharmaceutical product

(1 mark)

(ii) A sales commission on every sale for a company

(1 mark)

(iii) Repayment of a loan by company B to the bank

(1 mark)

(iv) A young woman wants to spend her time either working as a financial advisor or volunteering for a non-profit

(1 mark)

(v) Credit card fees charged to a business if the business enters into a credit purchase with customers

(1 mark)

(b) The Batu Pahat Kayak Company has these awesome new kayaks they are going to introduce to the market. They are a new company and need help in determining pricing, costs and how many kayaks they will need to sell in a month to break even. They are looking to you to help them determine if the selling price and costs will help them to reach their goals. They give you the following information shown in **Table Q4(b)** to work with;

Table Q4(b)

NO.	ITEMS	COST (RM)
1	Price per kayak	500
2	Variable cost per kayak	225
3	Fixed cost per month	7,700

(i) Determine the breakeven point.

(5 marks)

(ii) Batu Pahat Kayak has a few investors who are interested in getting a return on their investment. They have talked with your supervisor, and between them all, would like to get RM 30,000 a month in profit to divide between them. Calculate how many kayaks need to be sold in order to get the investors their return.

(5 marks)

(iii) Determine how much in sales do we need.

(3 marks)

(c) A defense contractor has been able to summarize its total annual fixed costs as RM 100,000 and the total variable cost per unit of production as RM 33.

(i) If only 5,000 units is all that is expected to sell to the government this year, determine what should the per unit selling price be to make a 25% profit this year.

(4 marks)

(ii) If foreign sales of 3,000 units per year is to be added to the 5,000 units government contract above and a 25% profit is acceptable for this contractor again, determine what could be the new selling price per unit.

(3 marks)

Q5 (a) You are plan to invest RM (3,000 + 1,000 x L3D) in a digital company **ONE (1)** year from now. The investment provides return rate 6% per year compounded quarterly. Assume that you do not withdraw the money earned at the end of each year, but instead let it accumulate. Noted that L3D represents the Last Three Digit of student matric number

(i) Calculate the nominal interest rate per quarter

(3 marks)

(ii) Determine the effective interest rate per year

(5 marks)

(iii) From **Q5(ii)**, compute the amount of investment after **THREE (3)** years.

(5 marks)

(b) Rahmat plans to withdraw his money RM 3,090 each year for five years, beginning at the 14th year. To keep his plan successful, he saves the money with the same amount each year.

(i) Draw a cash flow to represent the flow of saving and withdrawing of the money.

(3 marks)

(ii) Calculate how much money should he deposits each year for 12 years, starting from the first year. Assume the interest is 8% per year.

(9 marks)

- END OF QUESTION –

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LIST OF FORMULA

1	TC = FC + VC(Q)	9	Conventional B-C ratio with PW B-C = PW(B) ÷ [(I – PW(MV)) +PW(O&M)]
2	TR = P x Q	10	Conventional B-C ratio with AW B-C = AW(B) ÷ [CR + AW(O&M)]
3	$I_{effective} = \left(1 + \frac{r}{m}\right)^m - 1$	11	Modified B-C ratio with PW B-C = [PW(B) – PW(O&M)] ÷ [I – PW(MV)]
4	$p\,(1 + i)^n$	12	Modified B-C ratio with PW B-C = [AW(B) – AW(O&M)] ÷ CR
5	$F = P\left(\frac{F}{P}, i, n\right) = P(1+i)^n$	13	$P = F\left(\frac{P}{F}, i, n\right) = F\left[\frac{1}{(1+i)^n}\right]$
6	$F = A\left(\frac{F}{A}, i, n\right) = A\left[\frac{(1+i)^n - 1}{i}\right]$	14	$A = F\left(\frac{A}{F}, i, n\right) = F\left[\frac{i}{(1+i)^n - 1}\right]$
7	$P = A\left(\frac{P}{A}, i, n\right) = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$	15	$A = P\left(\frac{A}{P}, i, n\right) = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$
8	$CR_k = -P(A/P, i, k) + S_k(A/F, i, k)$	16	$AW_k = - CR_k - AOC$

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INTEREST TABLE

6.0% Compound Interest Factors 6.0%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Compound Amount Factor	Present Worth Factor	Gradient Uniform Series	Gradient Present Worth	
	Find *F* Given *P*	Find *P* Given *F*	Find *A* Given *F*	Find *A* Given *P*	Find *F* Given *A*	Find *P* Given *A*	Find *A* Given *G*	Find *P* Given *G*	
n	***F/P***	***P/F***	***A/F***	***A/P***	***F/A***	***P/A***	***A/G***	***P/G***	n
1	1.0600	0.9434	1.0000	1.0600	1.0000	0.943	0.000	0.000	1
2	1.1236	0.8900	0.4854	0.5454	2.060	1.833	0.485	0.890	2
3	1.1910	0.8396	0.3141	0.3741	3.184	2.673	0.961	2.569	3
4	1.2625	0.7921	0.2286	0.2886	4.375	3.465	1.427	4.946	4
5	1.3382	0.7473	0.1774	0.2374	5.637	4.212	1.884	7.935	5
6	1.4185	0.7050	0.1434	0.2034	6.975	4.917	2.330	11.459	6
7	1.5036	0.6651	0.1191	0.1791	8.394	5.582	2.768	15.450	7
8	1.5938	0.6274	0.1010	0.1610	9.897	6.210	3.195	19.842	8
9	1.6895	0.5919	0.0870	0.1470	11.491	6.802	3.613	24.577	9
10	1.7908	0.5584	0.0759	0.1359	13.181	7.360	4.022	29.602	10
11	1.8983	0.5268	0.0668	0.1268	14.972	7.887	4.421	34.870	11
12	2.0122	0.4970	0.0593	0.1193	16.870	8.384	4.811	40.337	12
13	2.1329	0.4688	0.0530	0.1130	18.882	8.853	5.192	45.963	13
14	2.2609	0.4423	0.0476	0.1076	21.015	9.295	5.564	51.713	14
15	2.3966	0.4173	0.0430	0.1030	23.276	9.712	5.926	57.555	15
16	2.5404	0.3936	0.0390	0.0990	25.673	10.106	6.279	63.459	16
17	2.6928	0.3714	0.0354	0.0954	28.213	10.477	6.624	69.401	17
18	2.8543	0.3503	0.0324	0.0924	30.906	10.828	6.960	75.357	18
19	3.0256	0.3305	0.0296	0.0896	33.760	11.158	7.287	81.306	19
20	3.2071	0.3118	0.0272	0.0872	36.786	11.470	7.605	87.230	20
21	3.3996	0.2942	0.0250	0.0850	39.993	11.764	7.915	93.114	21
22	3.6035	0.2775	0.0230	0.0830	43.392	12.042	8.217	98.941	22
23	3.8197	0.2618	0.0213	0.0813	46.996	12.303	8.510	104.701	23
24	4.0489	0.2470	0.0197	0.0797	50.816	12.550	8.795	110.381	24
25	4.2919	0.2330	0.0182	0.0782	54.865	12.783	9.072	115.973	25

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8.0% Compound Interest Factors 8.0%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Compound Amount Factor	Present Worth Factor	Gradient Uniform Series	Gradient Present Worth	
	Find *F* Given *P*	Find *P* Given *F*	Find *A* Given *F*	Find *A* Given *P*	Find *F* Given *A*	Find *P* Given *A*	Find *A* Given *G*	Find *P* Given *G*	
n	***F/P***	***P/F***	***A/F***	***A/P***	***F/A***	***P/A***	***A/G***	***P/G***	n
1	1.0800	0.9259	1.0000	1.0800	1.0000	0.926	0.000	0.000	1
2	1.1664	0.8573	0.4808	0.5608	2.080	1.783	0.481	0.857	2
3	1.2597	0.7938	0.3080	0.3880	3.246	2.577	0.949	2.445	3
4	1.3605	0.7350	0.2219	0.3019	4.506	3.312	1.404	4.650	4
5	1.4693	0.6806	0.1705	0.2505	5.867	3.993	1.846	7.372	5
6	1.5869	0.6302	0.1363	0.2163	7.336	4.623	2.276	10.523	6
7	1.7138	0.5835	0.1121	0.1921	8.923	5.206	2.694	14.024	7
8	1.8509	0.5403	0.0940	0.1740	10.637	5.747	3.099	17.806	8
9	1.9990	0.5002	0.0801	0.1601	12.488	6.247	3.491	21.808	9
10	2.1589	0.4632	0.0690	0.1490	14.487	6.710	3.871	25.977	10
11	2.3316	0.4289	0.0601	0.1401	16.645	7.139	4.240	30.266	11
12	2.5182	0.3971	0.0527	0.1327	18.977	7.536	4.596	34.634	12
13	2.7196	0.3677	0.0465	0.1265	21.495	7.904	4.940	39.046	13
14	2.9372	0.3405	0.0413	0.1213	24.215	8.244	5.273	43.472	14
15	3.1722	0.3152	0.0368	0.1168	27.152	8.559	5.594	47.886	15
16	3.4259	0.2919	0.0330	0.1130	30.324	8.851	5.905	52.264	16
17	3.7000	0.2703	0.0296	0.1096	33.750	9.122	6.204	56.588	17
18	3.9960	0.2502	0.0267	0.1067	37.450	9.372	6.492	60.843	18
19	4.3157	0.2317	0.0241	0.1041	41.446	9.604	6.770	65.013	19
20	4.6610	0.2145	0.0219	0.1019	45.762	9.818	7.037	69.090	20
21	5.0338	0.1987	0.0198	0.0998	50.423	10.017	7.294	73.063	21
22	5.4365	0.1839	0.0180	0.0980	55.457	10.201	7.541	76.926	22
23	5.8715	0.1703	0.0164	0.0964	60.893	10.371	7.779	80.673	23
24	6.3412	0.1577	0.0150	0.0950	66.765	10.529	8.007	84.300	24
25	6.8485	0.1460	0.0137	0.0937	73.106	10.675	8.225	87.804	25

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10% Compound Interest Factors 10%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Compound Amount Factor	Present Worth Factor	Gradient Uniform Series	Gradient Present Worth	
	Find *F* Given *P*	Find *P* Given *F*	Find *A* Given *F*	Find *A* Given *P*	Find *F* Given *A*	Find *P* Given *A*	Find *A* Given *G*	Find *P* Given *G*	
n	***F/P***	***P/F***	***A/F***	***A/P***	***F/A***	***P/A***	***A/G***	***P/G***	n
1	1.1000	0.9091	1.0000	1.1000	1.0000	0.909	0.000	0.000	1
2	1.2100	0.8264	0.4762	0.5762	2.100	1.736	0.476	0.826	2
3	1.3310	0.7513	0.3021	0.4021	3.310	2.487	0.937	2.329	3
4	1.4641	0.6830	0.2155	0.3155	4.641	3.170	1.381	4.378	4
5	1.6105	0.6209	0.1638	0.2638	6.105	3.791	1.810	6.862	5
6	1.7716	0.5645	0.1296	0.2296	7.716	4.355	2.224	9.684	6
7	1.9487	0.5132	0.1054	0.2054	9.487	4.868	2.622	12.763	7
8	2.1436	0.4665	0.0874	0.1874	11.436	5.335	3.004	16.029	8
9	2.3579	0.4241	0.0736	0.1736	13.579	5.759	3.372	19.421	9
10	2.5937	0.3855	0.0627	0.1627	15.937	6.145	3.725	22.891	10
11	2.8531	0.3505	0.0540	0.1540	18.531	6.495	4.064	26.396	11
12	3.1384	0.3186	0.0468	0.1468	21.384	6.814	4.388	29.901	12
13	3.4523	0.2897	0.0408	0.1408	24.523	7.103	4.699	33.377	13
14	3.7975	0.2633	0.0357	0.1357	27.975	7.367	4.996	36.800	14
15	4.1772	0.2394	0.0315	0.1315	31.772	7.606	5.279	40.152	15
16	4.5950	0.2176	0.0278	0.1278	35.950	7.824	5.549	43.416	16
17	5.0545	0.1978	0.0247	0.1247	40.545	8.022	5.807	46.582	17
18	5.5599	0.1799	0.0219	0.1219	45.599	8.201	6.053	49.640	18
19	6.1159	0.1635	0.0195	0.1195	51.159	8.365	6.286	52.583	19
20	6.7275	0.1486	0.0175	0.1175	57.275	8.514	6.508	55.407	20
21	7.4002	0.1351	0.0156	0.1156	64.002	8.649	6.719	58.110	21
22	8.1403	0.1228	0.0140	0.1140	71.403	8.772	6.919	60.689	22
23	8.9543	0.1117	0.0126	0.1126	79.543	8.883	7.108	63.146	23
24	9.8497	0.1015	0.0113	0.1113	88.497	8.985	7.288	65.481	24
25	10.835	0.0923	0.0102	0.1102	98.347	9.077	7.458	67.696	25

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18% Compound Interest Factors 18%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Compound Amount Factor	Present Worth Factor	Gradient Uniform Series	Gradient Present Worth	
	Find *F* Given *P*	Find *P* Given *F*	Find *A* Given *F*	Find *A* Given *P*	Find *F* Given *A*	Find *P* Given *A*	Find *A* Given *G*	Find *P* Given *G*	
n	***F/P***	***P/F***	***A/F***	***A/P***	***F/A***	***P/A***	***A/G***	***P/G***	n
1	1.1800	0.8475	1.0000	1.1800	1.000	0.847	0.000	0.000	1
2	1.3924	0.7182	0.4587	0.6387	2.180	1.566	0.459	0.718	2
3	1.6430	0.6086	0.2799	0.4599	3.572	2.174	0.890	1.935	3
4	1.9388	0.5158	0.1917	0.3717	5.215	2.690	1.295	3.483	4
5	2.2878	0.4371	0.1398	0.3198	7.154	3.127	1.673	5.231	5
6	2.6996	0.3704	0.1059	0.2859	9.442	3.498	2.025	7.083	6
7	3.1855	0.3139	0.0824	0.2624	12.142	3.812	2.353	8.967	7
8	3.7589	0.2660	0.0652	0.2452	15.327	4.078	2.656	10.829	8
9	4.4355	0.2255	0.0524	0.2324	19.086	4.303	2.936	12.633	9
10	5.2338	0.1911	0.0425	0.2225	23.521	4.494	3.194	14.352	10
11	6.1759	0.1619	0.0348	0.2148	28.755	4.656	3.430	15.972	11
12	7.2876	0.1372	0.0286	0.2086	34.931	4.793	3.647	17.481	12
13	8.5994	0.1163	0.0237	0.2037	42.219	4.910	3.845	18.877	13
14	10.1472	0.0985	0.0197	0.1997	50.818	5.008	4.025	20.158	14
15	11.9737	0.0835	0.0164	0.1964	60.965	5.092	4.189	21.327	15
16	14.1290	0.0708	0.0137	0.1937	72.939	5.162	4.337	22.389	16
17	16.6722	0.0600	0.0115	0.1915	87.068	5.222	4.471	23.348	17
18	19.6733	0.0508	0.0096	0.1896	103.740	5.273	4.592	24.212	18
19	23.2144	0.0431	0.0081	0.1881	123.414	5.316	4.700	24.988	19
20	27.3930	0.0365	0.0068	0.1868	146.628	5.353	4.798	25.681	20
21	32.324	0.0309	0.0057	0.1857	174.021	5.384	4.885	26.300	21
22	38.142	0.0262	0.0048	0.1848	206.345	5.410	4.963	26.851	22
23	45.008	0.0222	0.0041	0.1841	244.487	5.432	5.033	27.339	23
24	53.109	0.0188	0.0035	0.1835	289.494	5.451	5.095	27.772	24
25	62.669	0.0160	0.0029	0.1829	342.603	5.467	5.150	28.155	25

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	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Compound Amount Factor	Present Worth Factor	Gradient Uniform Series	Gradient Present Worth	
	Find *F*	Find *P*	Find *A*	Find *A*	Find *F*	Find *P*	Find *A*	Find *P*	
	Given *P*	Given *F*	Given *F*	Given *P*	Given *A*	Given *A*	Given *G*	Given *G*	
n	***F/P***	***P/F***	***A/F***	***A/P***	***F/A***	***P/A***	***A/G***	***P/G***	n
1	1.2000	0.8333	1.0000	1.2000	1.0000	0.833	0.000	0.000	1
2	1.4400	0.6944	0.4545	0.6545	2.200	1.528	0.455	0.694	2
3	1.7280	0.5787	0.2747	0.4747	3.640	2.106	0.879	1.852	3
4	2.0736	0.4823	0.1863	0.3863	5.368	2.589	1.274	3.299	4
5	2.4883	0.4019	0.1344	0.3344	7.442	2.991	1.641	4.906	5
6	2.9860	0.3349	0.1007	0.3007	9.930	3.326	1.979	6.581	6
7	3.5832	0.2791	0.0774	0.2774	12.916	3.605	2.290	8.255	7
8	4.2998	0.2326	0.0606	0.2606	16.499	3.837	2.576	9.883	8
9	5.1598	0.1938	0.0481	0.2481	20.799	4.031	2.836	11.434	9
10	6.1917	0.1615	0.0385	0.2385	25.959	4.192	3.074	12.887	10
11	7.4301	0.1346	0.0311	0.2311	32.150	4.327	3.289	14.233	11
12	8.9161	0.1122	0.0253	0.2253	39.581	4.439	3.484	15.467	12
13	10.699	0.0935	0.0206	0.2206	48.497	4.533	3.660	16.588	13
14	12.839	0.0779	0.0169	0.2169	59.196	4.611	3.817	17.601	14
15	15.407	0.0649	0.0139	0.2139	72.035	4.675	3.959	18.509	15
16	18.488	0.0541	0.0114	0.2114	87.442	4.730	4.085	19.321	16
17	22.186	0.0451	0.0094	0.2094	105.931	4.775	4.198	20.042	17
18	26.623	0.0376	0.0078	0.2078	128.117	4.812	4.298	20.680	18
19	31.948	0.0313	0.0065	0.2065	154.740	4.843	4.386	21.244	19
20	38.338	0.0261	0.0054	0.2054	186.688	4.870	4.464	21.739	20
21	46.005	0.0217	0.0044	0.2044	225.026	4.891	4.533	22.174	21
22	55.206	0.0181	0.0037	0.2037	271.031	4.909	4.594	22.555	22
23	66.247	0.0151	0.0031	0.2031	326.237	4.925	4.647	22.887	23
24	79.497	0.0126	0.0025	0.2025	392.484	4.937	4.694	23.176	24
25	95.396	0.0105	0.0021	0.2021	471.981	4.948	4.735	23.428	25