所別：營建管理研究所碩士班 不分組 科目：工程經濟與統計

第一部份：工程統計（共五十分）

1. Short answer questions: (6 pts each, totally 18 pts)
   a. Compare 'normal distribution' and 't distribution'.
   b. Explain the meaning of MSE (Mean Square Error) and its application.
   c. Explain the relationship between 'Central Limit Theory' and PERT.

2. A highway tunnel is under construction using the D&B method. The total length of the tunnel is 240m. The progressing cycle is set to be 1 m. So far, 20 progressing cycles have been completed. Their respective cycle times are listed in the table below.

Unit: hour

10.8	10.2	9.8	11.4
10.6	8.6	10.6	9.2
11.8	11.4	45.5	10.2
34.0	11.6	10.2	12.8
10.2	12.0	10.4	11.2

   a. Calculate the Mean, Mode, Median and Standard deviation of the cycle time. (12 pts)
   b. With 95% confidence interval, how much more time is needed to complete the work? (5 pts)

3. 妳（你）的任務是決定信賴預拌廠出廠的 280 kgf/cm^2 混凝土是否合乎品質強度要求，如何應用工程統計方法幫妳（你）達成任務，試詳述之（包括取樣數、取樣方法等）。（15 分）

第二部份：工程經濟（共五十分）

An engineer intends to earn profits from engineering consulting kind projects and has decided to choose profitable ones as the very first step to his career. His performance significantly depends on the projects he chooses and, of course, the detailed information of each project can be obtained online accordingly (listed in the following table). Now he has $500,000 budget to bid and run the projects. Here comes information (i. and ii.) of the projects:

i. ***Basic information:*** Assume: (1) the Minimum Attractive Rate of Return (MARR) for these projects is equal to the engineer's costs of capital. (2) The capital used for the projects comes from only two resources of: a loan (a half of the total capital) and investors' capital (a half of the total capital). The after-tax interest rate for the loan is at 1% monthly and the expected after-tax rate of return for these investors is set to 3% monthly. (3) There is no salvage value for the projects. The detailed information of capital investment, cash flows, and study period is stated in the following table.

Project	Capital investment (×$1,000)	Cash flows (×$1,000)	Study period (month)
A	$180	• $500 monthly costs for overhead; • $1200 revenues every other month (starting from Month 2)	6
B	$300	• $800 monthly costs for overhead; • $900 revenues every month (starting from Month 1)	8
C	$200	• $400 monthly costs for overhead; • $500 revenues every month (starting from Month 1)	6
D	$160	• $200 monthly costs for overhead; • $800 revenues at Month 1	4
E	$150	• $300 monthly costs for overhead; • $1600 revenues at the end of study period	4

ii. ***Interrelationships among the projects:***
(1) Two or more projects must be chosen.
(2) A is independent on all except C and is mutually exclusive to C; B is independent on all except E and is mutually exclusive to E; and C is independent on all except A.
(3) D is contingent on the acceptance of E which is contingent on the acceptance of C.

請回答下列問題(折現率查表請參照第二、三頁):
(a) 若折現率等於 MARR，求出本題組之稅後月折現率 (5 分)。
(b) 利用(a)所求出之折現率與 Capital Worth (CW)方法，求出 A~E 五個專案之各別 CW 值 (15 分)。
(c) 利用(a)所求出之折現率與 CW 方法比較 A~E 五個專案，並求出最佳之專案與其 CW 值 (10 分)。此一比較基於何種假設 (5 分)?
(d) 根據(i.)與(ii.)，列出所有可能專案組合 (5 分)，並求出可行之最佳專案組合與其 CW 值 (10 分)。

注意：背面有試題

所別：營建管理研究所碩士班 不分組 科目：工程經濟與統計

Table A-1 Present Value of $1 Due at the End of n Periods:

Equation:

$$PVIF_{i,n} = \frac{1}{(1+i)^n}$$

Financial Calculator Keys:

n	i		0	1.0
N	I	PV	PMT	FV
		TABLE VALUE		

Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	14%	15%	16%	18%	20%	24%	28%	32%	36%
1	.9901	.9804	.9709	.9615	.9524	.9434	.9346	.9259	.9174	.9091	.8929	.8772	.8696	.8621	.8475	.8333	.8065	.7813	.7576	.7353
2	.9803	.9612	.9426	.9246	.9070	.8900	.8734	.8573	.8417	.8264	.7972	.7695	.7561	.7432	.7182	.6944	.6504	.6104	.5739	.5407
3	.9706	.9423	.9151	.8890	.8638	.8396	.8163	.7938	.7722	.7513	.7118	.6750	.6575	.6407	.6086	.5787	.5245	.4768	.4348	.3975
4	.9610	.9238	.8885	.8548	.8227	.7921	.7629	.7350	.7084	.6830	.6355	.5921	.5718	.5523	.5158	.4823	.4230	.3725	.3294	.2923
5	.9515	.9057	.8626	.8219	.7835	.7473	.7130	.6806	.6499	.6209	.5674	.5194	.4972	.4761	.4371	.4019	.3411	.2910	.2495	.2149
6	.9420	.8880	.8375	.7903	.7462	.7050	.6663	.6302	.5963	.5645	.5066	.4556	.4323	.4104	.3704	.3349	.2751	.2274	.1890	.1580
7	.9327	.8706	.8131	.7599	.7107	.6651	.6227	.5835	.5470	.5132	.4523	.3996	.3759	.3538	.3139	.2791	.2218	.1776	.1432	.1162
8	.9235	.8535	.7894	.7307	.6768	.6274	.5820	.5403	.5019	.4665	.4039	.3506	.3269	.3050	.2660	.2326	.1789	.1388	.1085	.0854
9	.9143	.8368	.7664	.7026	.6446	.5919	.5439	.5002	.4604	.4241	.3606	.3075	.2843	.2630	.2255	.1938	.1443	.1084	.0822	.0628
10	.9053	.8203	.7441	.6756	.6139	.5584	.5083	.4632	.4224	.3855	.3220	.2697	.2472	.2267	.1911	.1615	.1164	.0847	.0623	.0462
11	.8963	.8043	.7224	.6496	.5847	.5268	.4751	.4289	.3875	.3505	.2875	.2366	.2149	.1954	.1619	.1346	.0938	.0662	.0472	.0340
12	.8874	.7885	.7014	.6246	.5568	.4970	.4440	.3971	.3555	.3186	.2567	.2076	.1869	.1685	.1372	.1122	.0757	.0517	.0357	.0250
13	.8787	.7730	.6810	.6006	.5303	.4688	.4150	.3677	.3262	.2897	.2292	.1821	.1625	.1452	.1163	.0935	.0610	.0404	.0271	.0184
14	.8700	.7579	.6611	.5775	.5051	.4423	.3878	.3405	.2992	.2633	.2046	.1597	.1413	.1252	.0985	.0779	.0492	.0316	.0205	.0135
15	.8613	.7430	.6419	.5553	.4810	.4173	.3624	.3152	.2745	.2394	.1827	.1401	.1229	.1079	.0835	.0649	.0397	.0247	.0155	.0099
16	.8528	.7284	.6232	.5339	.4581	.3936	.3387	.2919	.2519	.2176	.1631	.1229	.1069	.0930	.0708	.0541	.0320	.0193	.0118	.0073
17	.8444	.7142	.6050	.5134	.4363	.3714	.3166	.2703	.2311	.1978	.1456	.1078	.0929	.0802	.0600	.0451	.0258	.0150	.0089	.0054
18	.8360	.7002	.5874	.4936	.4155	.3503	.2959	.2502	.2120	.1799	.1300	.0946	.0808	.0691	.0508	.0376	.0208	.0118	.0068	.0039
19	.8277	.6864	.5703	.4746	.3957	.3305	.2765	.2317	.1945	.1635	.1161	.0829	.0703	.0596	.0431	.0313	.0168	.0092	.0051	.0029
20	.8195	.6730	.5537	.4564	.3769	.3118	.2584	.2145	.1784	.1486	.1037	.0728	.0611	.0514	.0365	.0261	.0135	.0072	.0039	.0021
21	.8114	.6598	.5375	.4388	.3589	.2942	.2415	.1987	.1637	.1351	.0926	.0638	.0531	.0443	.0309	.0217	.0109	.0056	.0029	.0016
22	.8034	.6468	.5219	.4220	.3418	.2775	.2257	.1839	.1502	.1228	.0826	.0560	.0462	.0382	.0262	.0181	.0088	.0044	.0022	.0012
23	.7954	.6342	.5067	.4057	.3256	.2618	.2109	.1703	.1378	.1117	.0738	.0491	.0402	.0329	.0222	.0151	.0071	.0034	.0017	.0008
24	.7876	.6217	.4919	.3901	.3101	.2470	.1971	.1577	.1264	.1015	.0659	.0431	.0349	.0284	.0188	.0126	.0057	.0027	.0013	.0006
25	.7798	.6095	.4776	.3751	.2953	.2330	.1842	.1460	.1160	.0923	.0588	.0378	.0304	.0245	.0160	.0105	.0046	.0021	.0010	.0005
26	.7720	.5976	.4637	.3607	.2812	.2198	.1722	.1352	.1064	.0839	.0525	.0331	.0264	.0211	.0135	.0087	.0037	.0016	.0007	.0003
27	.7644	.5859	.4502	.3468	.2678	.2074	.1609	.1252	.0976	.0763	.0469	.0291	.0230	.0182	.0115	.0073	.0030	.0013	.0006	.0002
28	.7568	.5744	.4371	.3335	.2551	.1956	.1504	.1159	.0895	.0693	.0419	.0255	.0200	.0157	.0097	.0061	.0024	.0010	.0004	.0002
29	.7493	.5631	.4243	.3207	.2429	.1846	.1406	.1073	.0822	.0630	.0374	.0224	.0174	.0135	.0082	.0051	.0020	.0008	.0003	.0001
30	.7419	.5521	.4120	.3083	.2314	.1741	.1314	.0994	.0754	.0573	.0334	.0196	.0151	.0116	.0070	.0042	.0016	.0006	.0002	.0001
35	.7059	.5000	.3554	.2534	.1813	.1301	.0937	.0676	.0490	.0356	.0189	.0102	.0073	.0055	.0030	.0017	.0005	.0002	.0001	*
40	.6717	.4529	.3066	.2083	.1420	.0972	.0668	.0460	.0318	.0221	.0107	.0053	.0037	.0026	.0013	.0007	.0002	.0001	*	*
45	.6391	.4102	.2644	.1712	.1113	.0727	.0476	.0313	.0207	.0137	.0061	.0027	.0019	.0013	.0006	.0003	.0001	*	*	*
50	.6080	.3715	.2281	.1407	.0872	.0543	.0339	.0213	.0134	.0085	.0035	.0014	.0009	.0006	.0003	.0001	*	*	*	*
55	.5785	.3365	.1968	.1157	.0683	.0406	.0242	.0145	.0087	.0053	.0020	.0007	.0005	.0003	.0001	*	*	*	*	*

*The factor is zero to four decimal places.

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Table A-2 Present Value of an Annuity of $1 per Period for n Periods:

Equation:

$$PVIFA_{i,n} = \sum_{t=1}^{n} \frac{1}{(1+i)^t} = \frac{1 - \frac{1}{(1+i)^n}}{i} = \frac{1}{i} - \frac{1}{i(1+i)^n}$$

Financial Calculator Keys:

n	i		1.0	0
N	I	PV	PMT	FV
		TABLE VALUE		

Number of Periods	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	14%	15%	16%	18%	20%	24%	28%	32%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.8929	0.8772	0.8696	0.8621	0.8475	0.8333	0.8065	0.7813	0.7576
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833	1.7591	1.7355	1.6901	1.6467	1.6257	1.6052	1.5656	1.5278	1.4568	1.3916	1.3315
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771	2.5313	2.4869	2.4018	2.3216	2.2832	2.2459	2.1743	2.1065	1.9813	1.8684	1.7663
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121	3.2397	3.1699	3.0373	2.9137	2.8550	2.7982	2.6901	2.5887	2.4043	2.2410	2.0957
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6048	3.4331	3.3522	3.2743	3.1272	2.9906	2.7454	2.5320	2.3452
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.1114	3.8887	3.7845	3.6847	3.4976	3.3255	3.0205	2.7594	2.5342
7	6.7282	6.4720	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	5.0330	4.8684	4.5638	4.2883	4.1604	4.0386	3.8115	3.6046	3.2423	2.9370	2.6775
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.5348	5.3349	4.9676	4.6389	4.4873	4.3436	4.0776	3.8372	3.4212	3.0758	2.7860
9	8.5660	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.9952	5.7590	5.3282	4.9464	4.7716	4.6065	4.3030	4.0310	3.5655	3.1842	2.8681
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.4177	6.1446	5.6502	5.2161	5.0188	4.8332	4.4941	4.1925	3.6819	3.2689	2.9304
11	10.3676	9.7868	9.2526	8.7605	8.3064	7.8869	7.4987	7.1390	6.8052	6.4951	5.9377	5.4527	5.2337	5.0286	4.6560	4.3271	3.7757	3.3351	2.9776
12	11.2551	10.5753	9.9540	9.3851	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.1944	5.6603	5.4206	5.1971	4.7932	4.4392	3.8514	3.3868	3.0133
13	12.1337	11.3484	10.6350	9.9856	9.3936	8.8527	8.3577	7.9038	7.4869	7.1034	6.4235	5.8424	5.5831	5.3423	4.9095	4.5327	3.9124	3.4272	3.0404
14	13.0037	12.1062	11.2961	10.5631	9.8986	9.2950	8.7455	8.2442	7.7862	7.3667	6.6282	6.0021	5.7245	5.4675	5.0081	4.6106	3.9616	3.4587	3.0609
15	13.8651	12.8493	11.9379	11.1184	10.3797	9.7122	9.1079	8.5595	8.0607	7.6061	6.8109	6.1422	5.8474	5.5755	5.0916	4.6755	4.0013	3.4834	3.0764
16	14.7179	13.5777	12.5611	11.6523	10.8378	10.1059	9.4466	8.8514	8.3126	7.8237	6.9740	6.2651	5.9542	5.6685	5.1624	4.7296	4.0333	3.5026	3.0882
17	15.5623	14.2919	13.1661	12.1657	11.2741	10.4773	9.7632	9.1216	8.5436	8.0216	7.1196	6.3729	6.0472	5.7487	5.2223	4.7746	4.0591	3.5177	3.0971
18	16.3983	14.9920	13.7535	12.6593	11.6896	10.8276	10.0591	9.3719	8.7556	8.2014	7.2497	6.4674	6.1280	5.8178	5.2732	4.8122	4.0799	3.5294	3.1039
19	17.2260	15.6785	14.3238	13.1339	12.0853	11.1581	10.3356	9.6036	8.9501	8.3649	7.3658	6.5504	6.1982	5.8775	5.3162	4.8435	4.0967	3.5386	3.1090
20	18.0456	16.3514	14.8775	13.5903	12.4622	11.4699	10.5940	9.8181	9.1285	8.5136	7.4694	6.6231	6.2593	5.9288	5.3527	4.8696	4.1103	3.5458	3.1129
21	18.8570	17.0112	15.4150	14.0292	12.8212	11.7641	10.8355	10.0168	9.2922	8.6487	7.5620	6.6870	6.3125	5.9731	5.3837	4.8913	4.1212	3.5514	3.1158
22	19.6604	17.6580	15.9369	14.4511	13.1630	12.0416	11.0612	10.2007	9.4424	8.7715	7.6446	6.7429	6.3587	6.0113	5.4099	4.9094	4.1300	3.5558	3.1180
23	20.4558	18.2922	16.4436	14.8568	13.4886	12.3034	11.2722	10.3711	9.5802	8.8832	7.7184	6.7921	6.3988	6.0442	5.4321	4.9245	4.1371	3.5592	3.1197
24	21.2434	18.9139	16.9355	15.2470	13.7986	12.5504	11.4693	10.5288	9.7066	8.9847	7.7843	6.8351	6.4338	6.0726	5.4509	4.9371	4.1428	3.5619	3.1210
25	22.0232	19.5235	17.4131	15.6221	14.0939	12.7834	11.6536	10.6748	9.8226	9.0770	7.8431	6.8729	6.4641	6.0971	5.4669	4.9476	4.1474	3.5640	3.1220
26	22.7952	20.1210	17.8768	15.9828	14.3752	13.0032	11.8258	10.8100	9.9290	9.1609	7.8957	6.9061	6.4906	6.1182	5.4804	4.9563	4.1511	3.5656	3.1227
27	23.5596	20.7069	18.3270	16.3296	14.6430	13.2105	11.9867	10.9352	10.0266	9.2372	7.9426	6.9352	6.5135	6.1364	5.4919	4.9636	4.1542	3.5669	3.1233
28	24.3164	21.2813	18.7641	16.6631	14.8981	13.4062	12.1371	11.0511	10.1161	9.3066	7.9844	6.9607	6.5335	6.1520	5.5016	4.9697	4.1566	3.5679	3.1237
29	25.0658	21.8444	19.1885	16.9837	15.1411	13.5907	12.2777	11.1584	10.1983	9.3696	8.0218	6.9830	6.5509	6.1656	5.5098	4.9747	4.1585	3.5687	3.1240
30	25.8077	22.3965	19.6004	17.2920	15.3725	13.7648	12.4090	11.2578	10.2737	9.4269	8.0552	7.0027	6.5660	6.1772	5.5168	4.9789	4.1601	3.5693	3.1242
35	29.4086	24.9986	21.4872	18.6646	16.3742	14.4962	12.9477	11.6546	10.5668	9.6442	8.1755	7.0700	6.6166	6.2153	5.5386	4.9915	4.1644	3.5708	3.1248
40	32.8347	27.3555	23.1148	19.7928	17.1591	15.0463	13.3317	11.9246	10.7574	9.7791	8.2438	7.1050	6.6418	6.2335	5.5482	4.9966	4.1659	3.5712	3.1250
45	36.0945	29.4902	24.5187	20.7200	17.7741	15.4558	13.6055	12.1084	10.8812	9.8628	8.2825	7.1232	6.6543	6.2421	5.5523	4.9986	4.1664	3.5714	3.1250
50	39.1961	31.4236	25.7298	21.4822	18.2559	15.7619	13.8007	12.2335	10.9617	9.9148	8.3045	7.1327	6.6605	6.2463	5.5541	4.9995	4.1666	3.5714	3.1250
55	42.1472	33.1748	26.7744	22.1086	18.6335	15.9905	13.9399	12.3186	11.0140	9.9471	8.3170	7.1376	6.6636	6.2482	5.5549	4.9998	4.1666	3.5714	3.1250

注意：背面有試題

所別：營建管理研究所碩士班 不分組 科目：工程經濟與統計

Table A-3 • Future Value of $1 at the End of n Periods:

Equation:

$FVIF_{i,n} = (1 + i)^n$

Financial Calculator Keys:

n	i	1.0	0	
N	I	PV	PMT	FV
				TABLE VALUE

Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	14%	15%	16%	18%	20%	24%	28%	32%	36%
1	1.0100	1.0200	1.0300	1.0400	1.0500	1.0600	1.0700	1.0800	1.0900	1.1000	1.1200	1.1400	1.1500	1.1600	1.1800	1.2000	1.2400	1.2800	1.3200	1.3600
2	1.0201	1.0404	1.0609	1.0816	1.1025	1.1236	1.1449	1.1664	1.1881	1.2100	1.2544	1.2996	1.3225	1.3456	1.3924	1.4400	1.5376	1.6384	1.7424	1.8496
3	1.0303	1.0612	1.0927	1.1249	1.1576	1.1910	1.2250	1.2597	1.2950	1.3310	1.4049	1.4815	1.5209	1.5609	1.6430	1.7280	1.9066	2.0972	2.3000	2.5155
4	1.0406	1.0824	1.1255	1.1699	1.2155	1.2625	1.3108	1.3605	1.4116	1.4641	1.5735	1.6890	1.7490	1.8106	1.9388	2.0736	2.3642	2.6844	3.0360	3.4210
5	1.0510	1.1041	1.1593	1.2167	1.2763	1.3382	1.4026	1.4693	1.5386	1.6105	1.7623	1.9254	2.0114	2.1003	2.2878	2.4883	2.9316	3.4360	4.0075	4.6526
6	1.0615	1.1262	1.1941	1.2653	1.3401	1.4185	1.5007	1.5869	1.6771	1.7716	1.9738	2.1950	2.3131	2.4364	2.6996	2.9860	3.6352	4.3980	5.2899	6.3275
7	1.0721	1.1487	1.2299	1.3159	1.4071	1.5036	1.6058	1.7138	1.8280	1.9487	2.2107	2.5023	2.6600	2.8262	3.1855	3.5832	4.5077	5.6295	6.9826	8.6054
8	1.0829	1.1717	1.2668	1.3686	1.4775	1.5938	1.7182	1.8509	1.9926	2.1436	2.4760	2.8526	3.0590	3.2784	3.7589	4.2998	5.5895	7.2058	9.2170	11.703
9	1.0937	1.1951	1.3048	1.4233	1.5513	1.6895	1.8385	1.9990	2.1719	2.3579	2.7731	3.2519	3.5179	3.8030	4.4355	5.1598	6.9310	9.2234	12.166	15.917
10	1.1046	1.2190	1.3439	1.4802	1.6289	1.7908	1.9672	2.1589	2.3674	2.5937	3.1058	3.7072	4.0456	4.4114	5.2338	6.1917	8.5944	11.806	16.060	21.647
11	1.1157	1.2434	1.3842	1.5395	1.7103	1.8983	2.1049	2.3316	2.5804	2.8531	3.4785	4.2262	4.6524	5.1173	6.1759	7.4301	10.657	15.112	21.199	29.439
12	1.1268	1.2682	1.4258	1.6010	1.7959	2.0122	2.2522	2.5182	2.8127	3.1384	3.8960	4.8179	5.3503	5.9360	7.2876	8.9161	13.215	19.343	27.983	40.037
13	1.1381	1.2936	1.4685	1.6651	1.8856	2.1329	2.4098	2.7196	3.0658	3.4523	4.3635	5.4924	6.1528	6.8858	8.5994	10.699	16.386	24.759	36.937	54.451
14	1.1495	1.3195	1.5126	1.7317	1.9799	2.2609	2.5785	2.9372	3.3417	3.7975	4.8871	6.2613	7.0757	7.9875	10.147	12.839	20.319	31.691	48.757	74.053
15	1.1610	1.3459	1.5580	1.8009	2.0789	2.3966	2.7590	3.1722	3.6425	4.1772	5.4736	7.1379	8.1371	9.2655	11.974	15.407	25.196	40.565	64.359	100.71
16	1.1726	1.3728	1.6047	1.8730	2.1829	2.5404	2.9522	3.4259	3.9703	4.5950	6.1304	8.1372	9.3576	10.748	14.129	18.488	31.243	51.923	84.954	136.97
17	1.1843	1.4002	1.6528	1.9479	2.2920	2.6928	3.1588	3.7000	4.3276	5.0545	6.8660	9.2765	10.761	12.468	16.672	22.186	38.741	66.461	112.14	186.28
18	1.1961	1.4282	1.7024	2.0258	2.4066	2.8543	3.3799	3.9960	4.7171	5.5599	7.6900	10.575	12.375	14.463	19.673	26.623	48.039	85.071	148.02	253.34
19	1.2081	1.4568	1.7535	2.1068	2.5270	3.0256	3.6165	4.3157	5.1417	6.1159	8.6128	12.056	14.232	16.777	23.214	31.948	59.568	108.89	195.39	344.54
20	1.2202	1.4859	1.8061	2.1911	2.6533	3.2071	3.8697	4.6610	5.6044	6.7275	9.6463	13.743	16.367	19.461	27.393	38.338	73.864	139.38	257.92	468.57
21	1.2324	1.5157	1.8603	2.2788	2.7860	3.3996	4.1406	5.0338	6.1088	7.4002	10.804	15.668	18.822	22.574	32.324	46.005	91.592	178.41	340.45	637.26
22	1.2447	1.5460	1.9161	2.3699	2.9253	3.6035	4.4304	5.4365	6.6586	8.1403	12.100	17.861	21.645	26.186	38.142	55.206	113.57	228.36	449.39	866.67
23	1.2572	1.5769	1.9736	2.4647	3.0715	3.8197	4.7405	5.8715	7.2579	8.9543	13.552	20.362	24.891	30.376	45.008	66.247	140.83	292.30	593.20	1178.7
24	1.2697	1.6084	2.0328	2.5633	3.2251	4.0489	5.0724	6.3412	7.9111	9.8497	15.179	23.212	28.625	35.236	53.109	79.497	174.63	374.14	783.02	1603.0
25	1.2824	1.6406	2.0938	2.6658	3.3864	4.2919	5.4274	6.8485	8.6231	10.835	17.000	26.462	32.919	40.874	62.669	95.396	216.54	478.90	1033.6	2180.1
26	1.2953	1.6734	2.1566	2.7725	3.5557	4.5494	5.8074	7.3964	9.3992	11.918	19.040	30.167	37.857	47.414	73.949	114.48	268.51	613.00	1364.3	2964.9
27	1.3082	1.7069	2.2213	2.8834	3.7335	4.8223	6.2139	7.9881	10.245	13.110	21.325	34.390	43.535	55.000	87.260	137.37	332.95	784.64	1800.9	4032.3
28	1.3213	1.7410	2.2879	2.9987	3.9201	5.1117	6.6488	8.6271	11.167	14.421	23.884	39.204	50.066	63.800	102.97	164.84	412.86	1004.3	2377.2	5483.9
29	1.3345	1.7758	2.3566	3.1187	4.1161	5.4184	7.1143	9.3173	12.172	15.863	26.750	44.693	57.575	74.009	121.50	197.81	511.95	1285.6	3137.9	7458.1
30	1.3478	1.8114	2.4273	3.2434	4.3219	5.7435	7.6123	10.063	13.268	17.449	29.960	50.950	66.212	85.850	143.37	237.38	634.82	1645.5	4142.1	10143.
40	1.4889	2.2080	3.2620	4.8010	7.0400	10.286	14.974	21.725	31.409	45.259	93.051	188.88	267.86	378.72	750.38	1469.8	5455.9	19427.	66521.	*
50	1.6446	2.6916	4.3839	7.1067	11.467	18.420	29.457	46.902	74.358	117.39	289.00	700.23	1083.7	1670.7	3927.4	9100.4	46890.	*	*	*
60	1.8167	3.2810	5.8916	10.520	18.679	32.988	57.946	101.26	176.03	304.48	897.60	2595.9	4384.0	7370.2	20555.	56348.	*	*	*	*

*FVIF > 99,999.

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Table A-4 • Future Value of an Annuity of $1 per Period for n Periods:

Equation:

$$FVIFA_{i,n} = \sum_{t=1}^{n} (1 + i)^{n-t} = \frac{(1 + i)^n - 1}{i}$$

Financial Calculator Keys:

n	i	0	1.0	
N	I	PV	PMT	FV
				TABLE VALUE

Number of Periods	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	14%	15%	16%	18%	20%	24%	28%	32%	36%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600	2.0700	2.0800	2.0900	2.1000	2.1200	2.1400	2.1500	2.1600	2.1800	2.2000	2.2400	2.2800	2.3200	2.3600
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836	3.2149	3.2464	3.2781	3.3100	3.3744	3.4396	3.4725	3.5056	3.5724	3.6400	3.7776	3.9184	4.0624	4.2096
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746	4.4399	4.5061	4.5731	4.6410	4.7793	4.9211	4.9934	5.0665	5.2154	5.3680	5.6842	6.0156	6.3624	6.7251
5	5.1010	5.2040	5.3091	5.4163	5.5256	5.6371	5.7507	5.8666	5.9847	6.1051	6.3528	6.6101	6.7424	6.8771	7.1542	7.4416	8.0484	8.6999	9.3983	10.146
6	6.1520	6.3081	6.4684	6.6330	6.8019	6.9753	7.1533	7.3359	7.5233	7.7156	8.1152	8.5355	8.7537	8.9775	9.4420	9.9299	10.980	12.136	13.406	14.799
7	7.2135	7.4343	7.6625	7.8983	8.1420	8.3938	8.6540	8.9228	9.2004	9.4872	10.089	10.730	11.067	11.414	12.142	12.916	14.615	16.534	18.696	21.126
8	8.2857	8.5830	8.8923	9.2142	9.5491	9.8975	10.260	10.637	11.028	11.436	12.300	13.233	13.727	14.240	15.327	16.499	19.123	22.163	25.678	29.732
9	9.3685	9.7546	10.159	10.583	11.027	11.491	11.978	12.488	13.021	13.579	14.776	16.085	16.786	17.519	19.086	20.799	24.712	29.369	34.895	41.435
10	10.462	10.950	11.464	12.006	12.578	13.181	13.816	14.487	15.193	15.937	17.549	19.337	20.304	21.321	23.521	25.959	31.643	38.593	47.062	57.352
11	11.567	12.169	12.808	13.486	14.207	14.972	15.784	16.645	17.560	18.531	20.655	23.045	24.349	25.733	28.755	32.150	40.238	50.398	63.122	78.998
12	12.683	13.412	14.192	15.026	15.917	16.870	17.888	18.977	20.141	21.384	24.133	27.271	29.002	30.850	34.931	39.581	50.895	65.510	84.320	108.44
13	13.809	14.680	15.618	16.627	17.713	18.882	20.141	21.495	22.953	24.523	28.029	32.089	34.352	36.786	42.219	48.497	64.110	84.853	112.30	148.47
14	14.947	15.974	17.086	18.292	19.599	21.015	22.550	24.215	26.019	27.975	32.393	37.581	40.505	43.672	50.818	59.196	80.496	109.61	149.24	202.93
15	16.097	17.293	18.599	20.024	21.579	23.276	25.129	27.152	29.361	31.772	37.280	43.842	47.580	51.660	60.965	72.035	100.82	141.30	198.00	276.98
16	17.258	18.639	20.157	21.825	23.657	25.673	27.888	30.324	33.003	35.950	42.753	50.980	55.717	60.925	72.939	87.442	126.01	181.87	262.36	377.69
17	18.430	20.012	21.762	23.698	25.840	28.213	30.840	33.750	36.974	40.545	48.884	59.118	65.075	71.673	87.068	105.93	157.25	233.79	347.31	514.66
18	19.615	21.412	23.414	25.645	28.132	30.906	33.999	37.450	41.301	45.599	55.750	68.394	75.836	84.141	103.74	128.12	195.99	300.25	459.45	700.94
19	20.811	22.841	25.117	27.671	30.539	33.760	37.379	41.446	46.018	51.159	63.440	78.969	88.212	98.603	123.41	154.74	244.03	385.32	607.47	954.28
20	22.019	24.297	26.870	29.778	33.066	36.786	40.995	45.762	51.160	57.275	72.052	91.025	102.44	115.38	146.63	186.69	303.60	494.21	802.86	1298.8
21	23.239	25.783	28.676	31.969	35.719	39.993	44.865	50.423	56.765	64.002	81.699	104.77	118.81	134.84	174.02	225.03	377.46	633.59	1060.8	1767.4
22	24.472	27.299	30.537	34.248	38.505	43.392	49.006	55.457	62.873	71.403	92.503	120.44	137.63	157.41	206.34	271.03	469.06	812.00	1401.2	2404.7
23	25.716	28.845	32.453	36.618	41.430	46.996	53.436	60.893	69.532	79.543	104.60	138.30	159.28	183.60	244.49	326.24	582.63	1040.4	1850.6	3271.3
24	26.973	30.422	34.426	39.083	44.502	50.816	58.177	66.765	76.790	88.497	118.16	158.66	184.17	213.98	289.49	392.48	723.46	1332.7	2443.8	4450.0
25	28.243	32.030	36.459	41.646	47.727	54.865	63.249	73.106	84.701	98.347	133.33	181.87	212.79	249.21	342.60	471.98	898.09	1706.8	3226.8	6053.0
26	29.526	33.671	38.553	44.312	51.113	59.156	68.676	79.954	93.324	109.18	150.33	208.33	245.71	290.09	405.27	567.38	1114.6	2185.7	4260.4	8233.1
27	30.821	35.344	40.710	47.084	54.669	63.706	74.484	87.351	102.72	121.10	169.37	238.50	283.57	337.50	479.22	681.85	1383.1	2798.7	5624.8	11198.0
28	32.129	37.051	42.931	49.968	58.403	68.528	80.698	95.339	112.97	134.21	190.70	272.89	327.10	392.50	566.48	819.22	1716.1	3583.3	7425.7	15230.3
29	33.450	38.792	45.219	52.966	62.323	73.640	87.347	103.97	124.14	148.63	214.58	312.09	377.17	456.30	669.45	984.07	2129.0	4587.7	9802.9	20714.2
30	34.785	40.568	47.575	56.085	66.439	79.058	94.461	113.28	136.31	164.49	241.33	356.79	434.75	530.31	790.95	1181.9	2640.9	5873.2	12941.	28172.3
40	48.886	60.402	75.401	95.026	120.80	154.76	199.64	259.06	337.88	442.59	767.09	1342.0	1779.1	2360.8	4163.2	7343.9	22729.	69377.	*	*
50	64.463	84.579	112.80	152.67	209.35	290.34	406.53	573.77	815.08	1163.9	2400.0	4994.5	7217.7	10436.	21813.	45497.	*	*	*	*
60	81.670	114.05	163.05	237.99	353.58	533.13	813.32	1253.2	1944.8	3034.8	7471.6	18535.	29220.	46058.	*	*	*	*	*	*

*FVIFA > 99,999.

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