Karthik Patath
15 Feb 2021

Problem 5.1

1. **Baseline (No Masters):**

Current Age: 26 Years, Average Salary = $60,000/year, Inflation Rate = 5%

- After 5 years i.e. at the age of 31,
  PV = 60,000 x (P|A, 5%, 5) = 60,000 x 4.3295 = $259,770
- Retirement at the age of 55 years, i.e. after 29 years,
  PV = 60,000 x (P|A, 5% 29) = 60,000 x 15.1411 = $908,466
- Retirement at the age of 66 years, i.e. after 40 years,
  PV = 60,000 x (P|A, 5% 40) = 60,000 x 17.1591 = $1,029,546

2. **Option 1: Enroll for masters, pay full tuition $40,000 and graduate in one year:**

Current Age: 26 Years, Average Salary = $70,000/year, Inflation Rate = 5%

- After 5 years i.e. at the age of 31,
  Deducting initial tuition fees and no income for 1st year
  PV = -40,000 + 70,000 x (P|A, 5%, 5) – 70,000 x (P|A, 5%, 1)
  PV = -40,000 + 70,000 x 4.3295 – 70,000 x 0.9524 = $196,397
- Retirement at the age of 55 years, i.e. after 29 years,
  Deducting initial tuition fees and no income for 1st year
  PV = -40,000 + 70,000 x (P|A, 5%, 29) – 70,000 x (P|A, 5%, 1)
  PV = -40,000 + 70,000 x 15.1411 – 70,000 x 0.9524 = $953,209
- Retirement at the age of 66 years, i.e. after 40 years,
  Deducting initial tuition fees and no income for 1st year
  PV = -40,000 + 70,000 x (P|A, 5%, 40) – 70,000 x (P|A, 5%, 1)
  PV = -40,000 + 70,000 x 17.1591 – 70,000 x 0.9524 = $1,094,469

3. **Option 2: Enroll for masters, no tuition fee and graduate in two years:**

Current Age: 26 Years, Average Salary = $70,000/year, Inflation Rate = 5%

- After 5 years i.e. at the age of 31,
  No income for 2 years
  PV = 70,000 x (P|A, 5%, 5) – 70,000 x (P|A, 5%, 2)
  PV = 70,000 x 4.3295 – 70,000 x 1.8594 = $196,397
- Retirement at the age of 55 years, i.e. after 29 years,
  No income for 2 years
  PV = 70,000 x (P|A, 5%, 29) – 70,000 x (P|A, 5%, 2)
  PV = 70,000 x 15.1411 – 70,000 x 1.8594 = $929,719
- Retirement at the age of 66 years, i.e. after 40 years,
  No income for 2 years
  PV = 70,000 x (P|A, 5%, 40) – 70,000 x (P|A, 5%, 2)
  PV = 70,000 x 17.1591 – 70,000 x 1.8594 = $1,070,979

4. **Option 3: Enroll for masters, initial loan, graduate in one year:**

Current Age: 26 Years, Average Salary = $70,000/year, Inflation Rate = 5%, $5,000/year loan starting from year 2 to year 11

- After 5 years i.e. at the age of 31,
  No income for 1 year
  PV = [70,000 x (P|A, 5%, 5) – 70,000 x (P|A, 5%, 1)] - [5,000 x (P|A, 5%, 4) – 5,000 x (P|A, 5% , 1)]
  PV = (70,000 x 4.3295 – 70,000 x 0.9524) – (5,000 x 3.5459 – 5,000 x 0.9524) = $223,429
- Retirement at the age of 55 years, i.e. after 29 years,
  No income for 1 year
  PV = 70,000 x (P|A, 5%, 29) – 70,000 x (P|A, 5%, 1)] - [5,000 x (P|A, 5%, 11) – 5,000 x (P|A, 5% , 1)]
  PV = (70,000 x 15.1411 – 70,000 x 0.9524) – (5,000 x 8.3064 – 5,000 x 0.9524) = $956,439
- Retirement at the age of 66 years, i.e. after 40 years,
  No income for 1 year
  PV = 70,000 x (P|A, 5%, 40) – 70,000 x (P|A, 5%, 1)] - [5,000 x (P|A, 5%, 11) – 5,000 x (P|A, 5% , 1)]
  PV = (70,000 x 17.1591 – 70,000 x 0.9524) – (5,000 x 8.3064 – 5,000 x 0.9524) = $1,097,699

5. **Comparison Matrix:**

	Baseline	Option 1	Option 2	Option 3
After 5 Years	$259,770	$196,397	$196,397	$223,429
Retirement at 55 Years	$908,466	$953,209	$929,719	$956,439
Retirement at 65 Years	$1,029,546	$1,094,469	$1,070,979	$1,097,699

6. **Analysis:** It is apparent from the above matrix that the student would benefit from baseline option, that is, applying for a job immediately after getting B.S. degree and skipping masters for short term (after 5 years). However, Option 3 where the student borrows money and graduates within one year is more fruitful in both the scenarios where the student wants to retire at 55 years and 66 years.

Interest factors for Engineering Economy Present Worth Factor Equal Payments- To find P given A (P/A)																				
I VS nY	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.885	0.8772	0.8696	0.8621	0.8547	0.8475	0.8403	0.8333
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.808	1.7833	1.7591	1.7355	1.7125	1.6901	1.6681	1.6467	1.6257	1.6052	1.5852	1.5656	1.5465	1.5278
3	2.941	2.8839	2.8286	2.7751	2.7232	2.673	2.6243	2.5771	2.5313	2.4869	2.4437	2.4018	2.3612	2.3216	2.2832	2.2459	2.2096	2.1743	2.1399	2.1065
4	3.902	3.8077	3.7171	3.6299	3.546	3.4651	3.3872	3.3121	3.2397	3.1699	3.1024	3.0373	2.9745	2.9137	2.855	2.7982	2.7432	2.6901	2.6386	2.5887
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6959	3.6048	3.5172	3.4331	3.3522	3.2743	3.1993	3.1272	3.0576	2.9906
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.2305	4.1114	3.9975	3.8887	3.7845	3.6847	3.5892	3.4976	3.4098	3.3255
7	6.7282	6.472	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	5.033	4.8684	4.7122	4.5638	4.4226	4.2883	4.1604	4.0386	3.9224	3.8115	3.7057	3.6046
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.5348	5.3349	5.1461	4.9676	4.7988	4.6389	4.4873	4.3436	4.2072	4.0776	3.9544	3.8372
9	8.566	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.9952	5.759	5.537	5.3282	5.1317	4.9464	4.7716	4.6065	4.4506	4.303	4.1633	4.031
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.4177	6.1446	5.8892	5.6502	5.4262	5.2161	5.0188	4.8332	4.6586	4.4941	4.3389	4.1925
11	10.368	9.7868	9.2526	8.7605	8.3064	7.8869	7.4987	7.139	6.8052	6.4951	6.2065	5.9377	5.6869	5.4527	5.2337	5.0286	4.8364	4.656	4.4865	4.3271
12	11.255	10.575	9.954	9.3851	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.4924	6.1944	5.9176	5.6603	5.4206	5.1971	4.9884	4.7932	4.6105	4.4392
13	12.134	11.348	10.635	9.9856	9.3936	8.8527	8.3577	7.9038	7.4869	7.1034	6.7499	6.4235	6.1218	5.8424	5.5831	5.3423	5.1183	4.9095	4.7147	4.5327
14	13.004	12.106	11.296	10.563	9.8986	9.295	8.7455	8.2442	7.7862	7.3667	6.9819	6.6282	6.3025	6.0021	5.7245	5.4675	5.2293	5.0081	4.8023	4.6106
15	13.865	12.849	11.938	11.118	10.38	9.7122	9.1079	8.5595	8.0607	7.6061	7.1909	6.8109	6.4624	6.1422	5.8474	5.5755	5.3242	5.0916	4.8759	4.6755
16	14.718	13.578	12.561	11.652	10.838	10.106	9.4466	8.8514	8.3126	7.8237	7.3792	6.974	6.6039	6.2651	5.9542	5.6685	5.4053	5.1624	4.9377	4.7296
17	15.562	14.292	13.166	12.166	11.274	10.477	9.7632	9.1216	8.5436	8.0216	7.5488	7.1196	6.7291	6.3729	6.0472	5.7487	5.4746	5.2223	4.9897	4.7746
18	16.398	14.992	13.754	12.659	11.69	10.828	10.059	9.3719	8.7556	8.2014	7.7016	7.2497	6.8399	6.4674	6.128	5.8178	5.5339	5.2732	5.0333	4.8122
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.6036	8.9501	8.3649	7.8393	7.3658	6.938	6.5504	6.1982	5.8775	5.5845	5.3162	5.07	4.8435
20	18.046	16.351	14.877	13.59	12.462	11.47	10.594	9.8181	9.1285	8.5136	7.9633	7.4694	7.0248	6.6231	6.2593	5.9288	5.6278	5.3527	5.1009	4.8696
21	18.857	17.011	15.415	14.029	12.821	11.764	10.836	10.017	9.2922	8.6487	8.0751	7.562	7.1016	6.687	6.3125	5.9731	5.6648	5.3837	5.1268	4.8913
22	19.66	17.658	15.937	14.451	13.163	12.042	11.061	10.201	9.4424	8.7715	8.1757	7.6446	7.1695	6.7429	6.3587	6.0113	5.6964	5.4099	5.1486	4.9094
23	20.456	18.292	16.444	14.857	13.489	12.303	11.272	10.371	9.5802	8.8832	8.2664	7.7184	7.2297	6.7921	6.3988	6.0442	5.7234	5.4321	5.1668	4.9245
24	21.243	18.914	16.936	15.247	13.799	12.55	11.469	10.529	9.7066	8.9847	8.3481	7.7843	7.2829	6.8351	6.4338	6.0726	5.7465	5.4509	5.1822	4.9371
25	22.023	19.523	17.413	15.622	14.094	12.783	11.654	10.675	9.8226	9.077	8.4217	7.8431	7.33	6.8729	6.4641	6.0971	5.7662	5.4669	5.1951	4.9476
26	22.795	20.121	17.877	15.983	14.375	13.003	11.826	10.81	9.929	9.1609	8.4881	7.8957	7.3717	6.9061	6.4906	6.1182	5.7831	5.4804	5.206	4.9563
27	23.56	20.707	18.327	16.33	14.643	13.211	11.987	10.935	10.027	9.2372	8.5478	7.9426	7.4086	6.9352	6.5135	6.1364	5.7975	5.4919	5.2151	4.9636
28	24.316	21.281	18.764	16.663	14.898	13.406	12.137	11.051	10.116	9.3066	8.6016	7.9844	7.4412	6.9607	6.5335	6.152	5.8099	5.5016	5.2228	4.9697
29	25.066	21.844	19.188	16.984	15.141	13.591	12.278	11.158	10.198	9.3696	8.6501	8.0218	7.4701	6.983	6.5509	6.1656	5.8204	5.5098	5.2292	4.9747
30	25.808	22.396	19.6	17.292	15.372	13.765	12.409	11.258	10.274	9.4269	8.6938	8.0552	7.4957	7.0027	6.566	6.1772	5.8294	5.5168	5.2347	4.9789
31	26.542	22.938	20	17.588	15.593	13.929	12.532	11.35	10.343	9.479	8.7331	8.085	7.5183	7.0199	6.5791	6.1872	5.8371	5.5227	5.2392	4.9824
32	27.27	23.468	20.389	17.874	15.803	14.084	12.647	11.435	10.406	9.5264	8.7686	8.1116	7.5383	7.035	6.5905	6.1959	5.8437	5.5277	5.243	4.9854
33	27.99	23.989	20.766	18.148	16.003	14.23	12.754	11.514	10.464	9.5694	8.8005	8.1354	7.556	7.0482	6.6005	6.2034	5.8493	5.532	5.2462	4.9878
34	28.703	24.499	21.132	18.411	16.193	14.368	12.854	11.587	10.518	9.6086	8.8293	8.1566	7.5717	7.0599	6.6091	6.2098	5.8541	5.5356	5.2489	4.9898
35	29.409	24.999	21.487	18.665	16.374	14.498	12.948	11.655	10.567	9.6442	8.8552	8.1755	7.5856	7.07	6.6166	6.2153	5.8582	5.5386	5.2512	4.9915
36	30.108	25.489	21.832	18.908	16.547	14.621	13.035	11.717	10.612	9.6765	8.8786	8.1924	7.5979	7.079	6.6231	6.2201	5.8617	5.5412	5.2531	4.9929
37	30.8	25.969	22.167	19.143	16.711	14.737	13.117	11.775	10.653	9.7059	8.8996	8.2075	7.6087	7.0868	6.6288	6.2242	5.8647	5.5434	5.2547	4.9941
38	31.485	26.441	22.492	19.368	16.868	14.846	13.193	11.829	10.691	9.7327	8.9186	8.221	7.6183	7.0937	6.6338	6.2278	5.8673	5.5452	5.2561	4.9951
39	32.163	26.903	22.808	19.584	17.017	14.949	13.265	11.879	10.726	9.757	8.9357	8.233	7.6268	7.0997	6.638	6.2309	5.8695	5.5468	5.2572	4.9959
40	32.835	27.355	23.115	19.793	17.159	15.046	13.332	11.925	10.757	9.7791	8.9511	8.2438	7.6344	7.105	6.6418	6.2335	5.8713	5.5482	5.2582	4.9966

Problem 5.2

Assumption: Tax Rate = 33% and Straight-Line Depreciation for the Machine.

1. **Two-Cavity Mold:**

Each mold can make 200,000 parts lifetime and the company is targeting to produce 40,000 parts/year.
Therefore 200,000/40,000 = 5 years is the lifetime of two-cavity mold.
Depreciation = 45,000/5 = 9000/year.
And it will earn a profit of $0.25 x 40,000 = $10,000/year.
Investment = $45,000.

Year End	Before Tax Cash Flow	Depreciation	Taxable Income	Taxes	After Tax Cash Flow
A	B	C	D = B + C	E = -0.33*D	F = B + E
0	-45,000				
1	10,000	-9000	1000	-330	9670
2	10,000	-9000	1000	-330	9670
3	10,000	-9000	1000	-330	9670
4	10,000	-9000	1000	-330	9670
5	10,000	-9000	1000	-330	9670

PW T1; at i = 4% → -45,000 + (9670 x (P|A, 4%, 5)) = -45,000 + 9670(4.4518) = -1951.09
PW T2; at i = 3% → -45,000 + (9670 x (P|A, 3%, 5)) = -45,000 + 9670(4.5797) = -714.30
PW T3; at i = 2% → -45,000 + (9670 x (P|A, 2%, 5)) = -45,000 + 9670(4.7135) = 579.54

Prorating between 2% and 3%, $2 + \frac{579.54}{(579.54+714.30)} = 2 + 0.45 = \mathbf{2.45\%}$

2. **Four-Cavity Mold**:

Each mold can make 400,000 parts lifetime and the company is targeting to produce 40,000 parts/year.
Therefore 400,000/40,000 = 10 years is the lifetime of two-cavity mold.
Depreciation = 45,000/5 = 9000/year
And it will earn a profit of $0.25 x 40,000 = $10,000/year
Investment = $80,000

Year End	Before Tax Cash Flow	Depreciation	Taxable Income	Taxes	After Tax Cash Flow
A	B	C	D = B + C	E = -0.333*D	F = B + E
0	-80,000				
1	10,000	-8000	2000	-660	9340
2	10,000	-8000	2000	-660	9340
3	10,000	-8000	2000	-660	9340
4	10,000	-8000	2000	-660	9340
5	10,000	-8000	2000	-660	9340
6	10,000	-8000	2000	-660	9340
7	10,000	-8000	2000	-660	9340
8	10,000	-8000	2000	-660	9340
9	10,000	-8000	2000	-660	9340
10	10,000	-8000	2000	-660	9340

PW T1; at i = 4% → -80,000 + (9340 x (P|A, 4%, 10)) = -80,000 + 9340(8.1109) = -4244.19
PW T2; at i = 3% → -80,000 + (9340 x (P|A, 3%, 10)) = -80,000 + 9340(8.5302) = -327.93
PW T3; at i = 2% → -80,000 + (9340 x (P|A, 2%, 10)) = -80,000 + 9340(8.9826) = 3897.48

Prorating between 2% and 3%, $2 + \frac{3897.48}{(3897.48+327.93)} = 2 + 0.92 = \mathbf{2.92}\%$

3. **Conclusion:** Clearly, for four-cavity molding machine, the ROI is greater than two-cavity molding machine. Therefore, the second option can be preferred over first option of two-cavity molding machine.

Interest factors for Engineering Economy Present Worth Factor Equal Payments- To find P given A (P/A)																				
I VS nY	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.885	0.8772	0.8696	0.8621	0.8547	0.8475	0.8403	0.8333
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.808	1.7833	1.7591	1.7355	1.7125	1.6901	1.6681	1.6467	1.6257	1.6052	1.5852	1.5656	1.5465	1.5278
3	2.941	2.8839	2.8286	2.7751	2.7232	2.673	2.6243	2.5771	2.5313	2.4869	2.4437	2.4018	2.3612	2.3216	2.2832	2.2459	2.2096	2.1743	2.1399	2.1065
4	3.902	3.8077	3.7171	3.6299	3.546	3.4651	3.3872	3.3121	3.2397	3.1699	3.1024	3.0373	2.9745	2.9137	2.855	2.7982	2.7432	2.6901	2.6386	2.5887
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6959	3.6048	3.5172	3.4331	3.3522	3.2743	3.1993	3.1272	3.0576	2.9906
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.2305	4.1114	3.9975	3.8887	3.7845	3.6847	3.5892	3.4976	3.4098	3.3255
7	6.7282	6.472	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	5.033	4.8684	4.7122	4.5638	4.4226	4.2883	4.1604	4.0386	3.9224	3.8115	3.7057	3.6046
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.5348	5.3349	5.1461	4.9676	4.7988	4.6389	4.4873	4.3436	4.2072	4.0776	3.9544	3.8372
9	8.566	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.9952	5.759	5.537	5.3282	5.1317	4.9464	4.7716	4.6065	4.4506	4.303	4.1633	4.031
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.4177	6.1446	5.8892	5.6502	5.4262	5.2161	5.0188	4.8332	4.6586	4.4941	4.3389	4.1925
11	10.368	9.7868	9.2526	8.7605	8.3064	7.8869	7.4987	7.139	6.8052	6.4951	6.2065	5.9377	5.6869	5.4527	5.2337	5.0286	4.8364	4.656	4.4865	4.3271
12	11.255	10.575	9.954	9.3851	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.4924	6.1944	5.9176	5.6603	5.4206	5.1971	4.9884	4.7932	4.6105	4.4392
13	12.134	11.348	10.635	9.9856	9.3936	8.8527	8.3577	7.9038	7.4869	7.1034	6.7499	6.4235	6.1218	5.8424	5.5831	5.3423	5.1183	4.9095	4.7147	4.5327
14	13.004	12.106	11.296	10.563	9.8986	9.295	8.7455	8.2442	7.7862	7.3667	6.9819	6.6282	6.3025	6.0021	5.7245	5.4675	5.2293	5.0081	4.8023	4.6106
15	13.865	12.849	11.938	11.118	10.38	9.7122	9.1079	8.5595	8.0607	7.6061	7.1909	6.8109	6.4624	6.1422	5.8474	5.5755	5.3242	5.0916	4.8759	4.6755
16	14.718	13.578	12.561	11.652	10.838	10.106	9.4466	8.8514	8.3126	7.8237	7.3792	6.974	6.6039	6.2651	5.9542	5.6685	5.4053	5.1624	4.9377	4.7296
17	15.562	14.292	13.166	12.166	11.274	10.477	9.7632	9.1216	8.5436	8.0216	7.5488	7.1196	6.7291	6.3729	6.0472	5.7487	5.4746	5.2223	4.9897	4.7746
18	16.398	14.992	13.754	12.659	11.69	10.828	10.059	9.3719	8.7556	8.2014	7.7016	7.2497	6.8399	6.4674	6.128	5.8178	5.5339	5.2732	5.0333	4.8122
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.6036	8.9501	8.3649	7.8393	7.3658	6.938	6.5504	6.1982	5.8775	5.5845	5.3162	5.07	4.8435
20	18.046	16.351	14.877	13.59	12.462	11.47	10.594	9.8181	9.1285	8.5136	7.9633	7.4694	7.0248	6.6231	6.2593	5.9288	5.6278	5.3527	5.1009	4.8696
21	18.857	17.011	15.415	14.029	12.821	11.764	10.836	10.017	9.2922	8.6487	8.0751	7.562	7.1016	6.687	6.3125	5.9731	5.6648	5.3837	5.1268	4.8913
22	19.66	17.658	15.937	14.451	13.163	12.042	11.061	10.201	9.4424	8.7715	8.1757	7.6446	7.1695	6.7429	6.3587	6.0113	5.6964	5.4099	5.1486	4.9094
23	20.456	18.292	16.444	14.857	13.489	12.303	11.272	10.371	9.5802	8.8832	8.2664	7.7184	7.2297	6.7921	6.3988	6.0442	5.7234	5.4321	5.1668	4.9245
24	21.243	18.914	16.936	15.247	13.799	12.55	11.469	10.529	9.7066	8.9847	8.3481	7.7843	7.2829	6.8351	6.4338	6.0726	5.7465	5.4509	5.1822	4.9371
25	22.023	19.523	17.413	15.622	14.094	12.783	11.654	10.675	9.8226	9.077	8.4217	7.8431	7.33	6.8729	6.4641	6.0971	5.7662	5.4669	5.1951	4.9476
26	22.795	20.121	17.877	15.983	14.375	13.003	11.826	10.81	9.929	9.1609	8.4881	7.8957	7.3717	6.9061	6.4906	6.1182	5.7831	5.4804	5.206	4.9563
27	23.56	20.707	18.327	16.33	14.643	13.211	11.987	10.935	10.027	9.2372	8.5478	7.9426	7.4086	6.9352	6.5135	6.1364	5.7975	5.4919	5.2151	4.9636
28	24.316	21.281	18.764	16.663	14.898	13.406	12.137	11.051	10.116	9.3066	8.6016	7.9844	7.4412	6.9607	6.5335	6.152	5.8099	5.5016	5.2228	4.9697
29	25.066	21.844	19.188	16.984	15.141	13.591	12.278	11.158	10.198	9.3696	8.6501	8.0218	7.4701	6.983	6.5509	6.1656	5.8204	5.5098	5.2292	4.9747
30	25.808	22.396	19.6	17.292	15.372	13.765	12.409	11.258	10.274	9.4269	8.6938	8.0552	7.4957	7.0027	6.566	6.1772	5.8294	5.5168	5.2347	4.9789
31	26.542	22.938	20	17.588	15.593	13.929	12.532	11.35	10.343	9.479	8.7331	8.085	7.5183	7.0199	6.5791	6.1872	5.8371	5.5227	5.2392	4.9824
32	27.27	23.468	20.389	17.874	15.803	14.084	12.647	11.435	10.406	9.5264	8.7686	8.1116	7.5383	7.035	6.5905	6.1959	5.8437	5.5277	5.243	4.9854
33	27.99	23.989	20.766	18.148	16.003	14.23	12.754	11.514	10.464	9.5694	8.8005	8.1354	7.556	7.0482	6.6005	6.2034	5.8493	5.532	5.2462	4.9878
34	28.703	24.499	21.132	18.411	16.193	14.368	12.854	11.587	10.518	9.6086	8.8293	8.1566	7.5717	7.0599	6.6091	6.2098	5.8541	5.5356	5.2489	4.9898
35	29.409	24.999	21.487	18.665	16.374	14.498	12.948	11.655	10.567	9.6442	8.8552	8.1755	7.5856	7.07	6.6166	6.2153	5.8582	5.5386	5.2512	4.9915
36	30.108	25.489	21.832	18.908	16.547	14.621	13.035	11.717	10.612	9.6765	8.8786	8.1924	7.5979	7.079	6.6231	6.2201	5.8617	5.5412	5.2531	4.9929
37	30.8	25.969	22.167	19.143	16.711	14.737	13.117	11.775	10.653	9.7059	8.8996	8.2075	7.6087	7.0868	6.6288	6.2242	5.8647	5.5434	5.2547	4.9941
38	31.485	26.441	22.492	19.368	16.868	14.846	13.193	11.829	10.691	9.7327	8.9186	8.221	7.6183	7.0937	6.6338	6.2278	5.8673	5.5452	5.2561	4.9951
39	32.163	26.903	22.808	19.584	17.017	14.949	13.265	11.879	10.726	9.757	8.9357	8.233	7.6268	7.0997	6.638	6.2309	5.8695	5.5468	5.2572	4.9959
40	32.835	27.355	23.115	19.793	17.159	15.046	13.332	11.925	10.757	9.7791	8.9511	8.2438	7.6344	7.105	6.6418	6.2335	5.8713	5.5482	5.2582	4.9966

Problem 5.3

Production Capacity = 200,000 cells/year; Profit of 1 cell = $1.00; Net profit = $200,000/year

1. **Fully Automatic Machine; 33% Taxes; Salvage 10%; Five-Year Life:**

Year End	Before Tax Cash Flow	Depreciation	Taxable Income	Taxes	After Tax Cash Flow
A	B	C	D = B + C	E = -0.33*D	F = B + E
0	-800,000				
1	200,000	-160,000	40,000	-13,200	186,800
2	200,000	-160,000	40,000	-13,200	186,800
3	200,000	-160,000	40,000	-13,200	186,800
4	200,000	-160,000	40,000	-13,200	186,800
5	200,000	-160,000	40,000	-13,200	186,800
Book Value	80,000				

PW = -800,000 + 80,000 x (P|F, 10%, 5) + 186,800 x (P|A, i%, 5) = 0

∴ -800,000 + 80,000 x 0.6209 + 186,800(P|A, i%, 5) = 0

∴ (P|A, i%, 5) = 750328/186800

∴ (P|A, i%, 5) = 4.0167

From P|A table, this number lies in between 7% and 8%

For I = 7%, PW = -800,000 + 80,000 x 0.6209 + 186,800 x 4.1002 = $15,589.36
For I = 8%, PW = -800,000 + 80,000 x 0.6209 + 186,800 x 3.9927 = -$4,491.64
Prorating between 7% and 8%, $7 + \frac{15589.36}{(15589.36+4491.64)} = 7 + 0.78 = \mathbf{7.78}\%$

2. **Fully Automatic Machine; No Taxes; No Salvage; Five-Year Life:**

Year End	Before Tax Cash Flow
A	B
0	-800,000
1	200,000
2	200,000
3	200,000
4	200,000
5	200,000

PW = -800,000 + 200,000 x (P|A, i%, 5) = 0

∴ (P|A, i%, 5) = 4

From P|A table, this number lies in between 7% and 8%

For I = 7%, PW = -800,000 + 200,000 x 4.1002 = $20,040.00
For I = 8%, PW = -800,000 + 200,000 x 3.9927 = -$1,460.00
Prorating between 7% and 8%, $7 + \frac{20040}{(20040+1460)} = 7 + 0.93 = \mathbf{7.93}\%$

Production Capacity = 120,000 cells/year; Profit of 1 cell = $1.00; Net profit = $120,000/year

3. Semi-Automatic Machine; 33% Taxes; Salvage 10%; Five-Year Life:

Year End	Before Tax Cash Flow	Depreciation	Taxable Income	Taxes	After Tax Cash Flow
A	B	C	D = B + C	E = -0.33*D	F = B + E
0	-500,000				
1	120,000	-100,000	20,000	-6,600	113,400
2	120,000	-100,000	20,000	-6,600	113,400
3	120,000	-100,000	20,000	-6,600	113,400
4	120,000	-100,000	20,000	-6,600	113,400
5	120,000	-100,000	20,000	-6,600	113,400
Book Value	50,000				

PW = -500,000 + 50,000 x (P|F, 10%, 5) + 113,400 x (P|A, i%, 5) = 0

∴ -500,000 + 50,000 x 0.6209 + 113,400(P|A, i%, 5) = 0

∴ (P|A, i%, 5) = 468955/113400

∴ (P|A, i%, 5) = 4.1354

From P|A table, this number lies in between 6% and 7%

For I = 6%, PW = -500,000 + 50,000 x 0.6209 + 113,400 x 4.2124 = $8,731.16
For I = 7%, PW = -500,000 + 50,000 x 0.6209 + 113,400 x 4.1002 = -$3,992.32
Prorating between 6% and 7%, $6 + \frac{8731.16}{(8731.16+3992.32)} = 6 + 0.69 = \mathbf{6.69}\%$

4. Semi-Automatic Machine; No Taxes; No Salvage; Five-Year Life:

Year End	Before Tax Cash Flow
A	B
0	-500,000
1	120,000
2	120,000
3	120,000
4	120,000
5	120,000

PW = -500,000 + 120,000 x (P|A, i%, 5) = 0

∴ (P|A, i%, 5) = 4.1667

From P|A table, this number lies in between 6% and 7%

For I = 6%, PW = -500,000 + 120,000 x 4.2124 = $5,488.00
For I = 7%, PW = -500,000 + 120,000 x 4.1002 = -$7,976.00
Prorating between 6% and 7%, $6 + \frac{5,488.00}{(5,488.00+7,976.00)} = 6 + 0.41 = \mathbf{6.41}\%$

5. **Conclusion:**
   a. **With taxes and remaining book value: ROI of fully automatic machine is 7.78% which is greater than ROI of semi-automatic machine at 6.69%, hence planning for fully automatic machine is better.**
   b. **Without taxes and remaining book value: ROI of fully automatic machine is 7.93% which is greater than ROI of semi-automatic machine at 6.41%, hence planning for fully automatic machine is better.**

Interest factors for Engineering Economy Present Worth Factor Equal Payments- To find P given A (P/A)

I VS nY	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.885	0.8772	0.8696	0.8621	0.8547	0.8475	0.8403	0.8333
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.808	1.7833	1.7591	1.7355	1.7125	1.6901	1.6681	1.6467	1.6257	1.6052	1.5852	1.5656	1.5465	1.5278
3	2.941	2.8839	2.8286	2.7751	2.7232	2.673	2.6243	2.5771	2.5313	2.4869	2.4437	2.4018	2.3612	2.3216	2.2832	2.2459	2.2096	2.1743	2.1399	2.1065
4	3.902	3.8077	3.7171	3.6299	3.546	3.4651	3.3872	3.3121	3.2397	3.1699	3.1024	3.0373	2.9745	2.9137	2.855	2.7982	2.7432	2.6901	2.6386	2.5887
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6959	3.6048	3.5172	3.4331	3.3522	3.2743	3.1993	3.1272	3.0576	2.9906
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.2305	4.1114	3.9975	3.8887	3.7845	3.6847	3.5892	3.4976	3.4098	3.3255
7	6.7282	6.472	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	5.033	4.8684	4.7122	4.5638	4.4226	4.2883	4.1604	4.0386	3.9224	3.8115	3.7057	3.6046
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.5348	5.3349	5.1461	4.9676	4.7988	4.6389	4.4873	4.3436	4.2072	4.0776	3.9544	3.8372
9	8.566	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.9952	5.759	5.537	5.3282	5.1317	4.9464	4.7716	4.6065	4.4506	4.303	4.1633	4.031
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.4177	6.1446	5.8892	5.6502	5.4262	5.2161	5.0188	4.8332	4.6586	4.4941	4.3389	4.1925
11	10.368	9.7868	9.2526	8.7605	8.3064	7.8869	7.4987	7.139	6.8052	6.4951	6.2065	5.9377	5.6869	5.4527	5.2337	5.0286	4.8364	4.656	4.4865	4.3271
12	11.255	10.575	9.954	9.3851	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.4924	6.1944	5.9176	5.6603	5.4206	5.1971	4.9884	4.7932	4.6105	4.4392
13	12.134	11.348	10.635	9.9856	9.3936	8.8527	8.3577	7.9038	7.4869	7.1034	6.7499	6.4235	6.1218	5.8424	5.5831	5.3423	5.1183	4.9095	4.7147	4.5327
14	13.004	12.106	11.296	10.563	9.8986	9.295	8.7455	8.2442	7.7862	7.3667	6.9819	6.6282	6.3025	6.0021	5.7245	5.4675	5.2293	5.0081	4.8023	4.6106
15	13.865	12.849	11.938	11.118	10.38	9.7122	9.1079	8.5595	8.0607	7.6061	7.1909	6.8109	6.4624	6.1422	5.8474	5.5755	5.3242	5.0916	4.8759	4.6755
16	14.718	13.578	12.561	11.652	10.838	10.106	9.4466	8.8514	8.3126	7.8237	7.3792	6.974	6.6039	6.2651	5.9542	5.6685	5.4053	5.1624	4.9377	4.7296
17	15.562	14.292	13.166	12.166	11.274	10.477	9.7632	9.1216	8.5436	8.0216	7.5488	7.1196	6.7291	6.3729	6.0472	5.7487	5.4746	5.2223	4.9897	4.7746
18	16.398	14.992	13.754	12.659	11.69	10.828	10.059	9.3719	8.7556	8.2014	7.7016	7.2497	6.8399	6.4674	6.128	5.8178	5.5339	5.2732	5.0333	4.8122
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.6036	8.9501	8.3649	7.8393	7.3658	6.938	6.5504	6.1982	5.8775	5.5845	5.3162	5.07	4.8435
20	18.046	16.351	14.877	13.59	12.462	11.47	10.594	9.8181	9.1285	8.5136	7.9633	7.4694	7.0248	6.6231	6.2593	5.9288	5.6278	5.3527	5.1009	4.8696
21	18.857	17.011	15.415	14.029	12.821	11.764	10.836	10.017	9.2922	8.6487	8.0751	7.562	7.1016	6.687	6.3125	5.9731	5.6648	5.3837	5.1268	4.8913
22	19.66	17.658	15.937	14.451	13.163	12.042	11.061	10.201	9.4424	8.7715	8.1757	7.6446	7.1695	6.7429	6.3587	6.0113	5.6964	5.4099	5.1486	4.9094
23	20.456	18.292	16.444	14.857	13.489	12.303	11.272	10.371	9.5802	8.8832	8.2664	7.7184	7.2297	6.7921	6.3988	6.0442	5.7234	5.4321	5.1668	4.9245
24	21.243	18.914	16.936	15.247	13.799	12.55	11.469	10.529	9.7066	8.9847	8.3481	7.7843	7.2829	6.8351	6.4338	6.0726	5.7465	5.4509	5.1822	4.9371
25	22.023	19.523	17.413	15.622	14.094	12.783	11.654	10.675	9.8226	9.077	8.4217	7.8431	7.33	6.8729	6.4641	6.0971	5.7662	5.4669	5.1951	4.9476
26	22.795	20.121	17.877	15.983	14.375	13.003	11.826	10.81	9.929	9.1609	8.4881	7.8957	7.3717	6.9061	6.4906	6.1182	5.7831	5.4804	5.206	4.9563
27	23.56	20.707	18.327	16.33	14.643	13.211	11.987	10.935	10.027	9.2372	8.5478	7.9426	7.4086	6.9352	6.5135	6.1364	5.7975	5.4919	5.2151	4.9636
28	24.316	21.281	18.764	16.663	14.898	13.406	12.137	11.051	10.116	9.3066	8.6016	7.9844	7.4412	6.9607	6.5335	6.152	5.8099	5.5016	5.2228	4.9697
29	25.066	21.844	19.188	16.984	15.141	13.591	12.278	11.158	10.198	9.3696	8.6501	8.0218	7.4701	6.983	6.5509	6.1656	5.8204	5.5098	5.2292	4.9747
30	25.808	22.396	19.6	17.292	15.372	13.765	12.409	11.258	10.274	9.4269	8.6938	8.0552	7.4957	7.0027	6.566	6.1772	5.8294	5.5168	5.2347	4.9789
31	26.542	22.938	20	17.588	15.593	13.929	12.532	11.35	10.343	9.479	8.7331	8.085	7.5183	7.0199	6.5791	6.1872	5.8371	5.5227	5.2392	4.9824
32	27.27	23.468	20.389	17.874	15.803	14.084	12.647	11.435	10.406	9.5264	8.7686	8.1116	7.5383	7.035	6.5905	6.1959	5.8437	5.5277	5.243	4.9854
33	27.99	23.989	20.766	18.148	16.003	14.23	12.754	11.514	10.464	9.5694	8.8005	8.1354	7.556	7.0482	6.6005	6.2034	5.8493	5.532	5.2462	4.9878
34	28.703	24.499	21.132	18.411	16.193	14.368	12.854	11.587	10.518	9.6086	8.8293	8.1566	7.5717	7.0599	6.6091	6.2098	5.8541	5.5356	5.2489	4.9898
35	29.409	24.999	21.487	18.665	16.374	14.498	12.948	11.655	10.567	9.6442	8.8552	8.1755	7.5856	7.07	6.6166	6.2153	5.8582	5.5386	5.2512	4.9915
36	30.108	25.489	21.832	18.908	16.547	14.621	13.035	11.717	10.612	9.6765	8.8786	8.1924	7.5979	7.079	6.6231	6.2201	5.8617	5.5412	5.2531	4.9929
37	30.8	25.969	22.167	19.143	16.711	14.737	13.117	11.775	10.653	9.7059	8.8996	8.2075	7.6087	7.0868	6.6288	6.2242	5.8647	5.5434	5.2547	4.9941
38	31.485	26.441	22.492	19.368	16.868	14.846	13.193	11.829	10.691	9.7327	8.9186	8.221	7.6183	7.0937	6.6338	6.2278	5.8673	5.5452	5.2561	4.9951
39	32.163	26.903	22.808	19.584	17.017	14.949	13.265	11.879	10.726	9.757	8.9357	8.233	7.6268	7.0997	6.638	6.2309	5.8695	5.5468	5.2572	4.9959
40	32.835	27.355	23.115	19.793	17.159	15.046	13.332	11.925	10.757	9.7791	8.9511	8.2438	7.6344	7.105	6.6418	6.2335	5.8713	5.5482	5.2582	4.9966

Interest factors for Engineering Economy Present Worth Factor single payment- To find P given F (P/F)

I VS nY	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696	0.8621	0.8547	0.8475	0.8403	0.8333
2	0.9803	0.9612	0.9426	0.9246	0.9070	0.8900	0.8734	0.8573	0.8417	0.8264	0.8116	0.7972	0.7831	0.7695	0.7561	0.7432	0.7305	0.7182	0.7062	0.6944
3	0.9706	0.9423	0.9151	0.8890	0.8638	0.8396	0.8163	0.7938	0.7722	0.7513	0.7312	0.7118	0.6931	0.6750	0.6575	0.6407	0.6244	0.6086	0.5934	0.5787
4	0.9610	0.9238	0.8885	0.8548	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830	0.6587	0.6355	0.6133	0.5921	0.5718	0.5523	0.5337	0.5158	0.4987	0.4823
5	0.9515	0.9057	0.8626	0.8219	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209	0.5935	0.5674	0.5428	0.5194	0.4972	0.4761	0.4561	0.4371	0.4190	0.4019
6	0.9420	0.8880	0.8375	0.7903	0.7462	0.7050	0.6663	0.6302	0.5963	0.5645	0.5346	0.5066	0.4803	0.4556	0.4323	0.4104	0.3898	0.3704	0.3521	0.3349
7	0.9327	0.8706	0.8131	0.7599	0.7107	0.6651	0.6227	0.5835	0.5470	0.5132	0.4817	0.4523	0.4251	0.3996	0.3759	0.3538	0.3332	0.3139	0.2959	0.2791
8	0.9235	0.8535	0.7894	0.7307	0.6768	0.6274	0.5820	0.5403	0.5019	0.4665	0.4339	0.4039	0.3762	0.3506	0.3269	0.3050	0.2848	0.2660	0.2487	0.2326
9	0.9143	0.8368	0.7664	0.7026	0.6446	0.5919	0.5439	0.5002	0.4604	0.4241	0.3909	0.3606	0.3329	0.3075	0.2843	0.2630	0.2434	0.2255	0.2090	0.1938
10	0.9053	0.8203	0.7441	0.6756	0.6139	0.5584	0.5083	0.4632	0.4224	0.3855	0.3522	0.3220	0.2946	0.2697	0.2472	0.2267	0.2080	0.1911	0.1756	0.1615
11	0.8963	0.8043	0.7224	0.6496	0.5847	0.5268	0.4751	0.4289	0.3875	0.3505	0.3173	0.2875	0.2607	0.2366	0.2149	0.1954	0.1778	0.1619	0.1476	0.1346
12	0.8874	0.7885	0.7014	0.6246	0.5568	0.4970	0.4440	0.3971	0.3555	0.3186	0.2858	0.2567	0.2307	0.2076	0.1869	0.1685	0.1520	0.1372	0.1240	0.1122
13	0.8787	0.7730	0.6810	0.6006	0.5303	0.4688	0.4150	0.3677	0.3262	0.2897	0.2575	0.2292	0.2042	0.1821	0.1625	0.1452	0.1299	0.1163	0.1042	0.0935
14	0.8700	0.7579	0.6611	0.5775	0.5051	0.4423	0.3878	0.3405	0.2992	0.2633	0.2320	0.2046	0.1807	0.1597	0.1413	0.1252	0.1110	0.0985	0.0876	0.0779
15	0.8613	0.7430	0.6419	0.5553	0.4810	0.4173	0.3624	0.3152	0.2745	0.2394	0.2090	0.1827	0.1599	0.1401	0.1229	0.1079	0.0949	0.0835	0.0736	0.0649
16	0.8528	0.7284	0.6232	0.5339	0.4581	0.3936	0.3387	0.2919	0.2519	0.2176	0.1883	0.1631	0.1415	0.1229	0.1069	0.0930	0.0811	0.0708	0.0618	0.0541
17	0.8444	0.7142	0.6050	0.5134	0.4363	0.3714	0.3166	0.2703	0.2311	0.1978	0.1696	0.1456	0.1252	0.1078	0.0929	0.0802	0.0693	0.0600	0.0520	0.0451
18	0.8360	0.7002	0.5874	0.4936	0.4155	0.3503	0.2959	0.2502	0.2120	0.1799	0.1528	0.1300	0.1108	0.0946	0.0808	0.0691	0.0592	0.0508	0.0437	0.0376
19	0.8277	0.6864	0.5703	0.4746	0.3957	0.3305	0.2765	0.2317	0.1945	0.1635	0.1377	0.1161	0.0981	0.0829	0.0703	0.0596	0.0506	0.0431	0.0367	0.0313
20	0.8195	0.6730	0.5537	0.4564	0.3769	0.3118	0.2584	0.2145	0.1784	0.1486	0.1240	0.1037	0.0868	0.0728	0.0611	0.0514	0.0433	0.0365	0.0308	0.0261
21	0.8114	0.6598	0.5375	0.4388	0.3589	0.2942	0.2415	0.1987	0.1637	0.1351	0.1117	0.0926	0.0768	0.0638	0.0531	0.0443	0.0370	0.0309	0.0259	0.0217
22	0.8034	0.6468	0.5219	0.4220	0.3418	0.2775	0.2257	0.1839	0.1502	0.1228	0.1007	0.0826	0.0680	0.0560	0.0462	0.0382	0.0316	0.0262	0.0218	0.0181
23	0.7954	0.6342	0.5067	0.4057	0.3256	0.2618	0.2109	0.1703	0.1378	0.1117	0.0907	0.0738	0.0601	0.0491	0.0402	0.0329	0.0270	0.0222	0.0183	0.0151
24	0.7876	0.6217	0.4919	0.3901	0.3101	0.2470	0.1971	0.1577	0.1264	0.1015	0.0817	0.0659	0.0532	0.0431	0.0349	0.0284	0.0231	0.0188	0.0154	0.0126
25	0.7798	0.6095	0.4776	0.3751	0.2953	0.2330	0.1842	0.1460	0.1160	0.0923	0.0736	0.0588	0.0471	0.0378	0.0304	0.0245	0.0197	0.0160	0.0129	0.0105
26	0.7720	0.5976	0.4637	0.3607	0.2812	0.2198	0.1722	0.1352	0.1064	0.0839	0.0663	0.0525	0.0417	0.0331	0.0264	0.0211	0.0169	0.0135	0.0109	0.0087
27	0.7644	0.5859	0.4502	0.3468	0.2678	0.2074	0.1609	0.1252	0.0976	0.0763	0.0597	0.0469	0.0369	0.0291	0.0230	0.0182	0.0144	0.0115	0.0091	0.0073
28	0.7568	0.5744	0.4371	0.3335	0.2551	0.1956	0.1504	0.1159	0.0895	0.0693	0.0538	0.0419	0.0326	0.0255	0.0200	0.0157	0.0123	0.0097	0.0077	0.0061
29	0.7493	0.5631	0.4243	0.3207	0.2429	0.1846	0.1406	0.1073	0.0822	0.0630	0.0485	0.0374	0.0289	0.0224	0.0174	0.0135	0.0105	0.0082	0.0064	0.0051
30	0.7419	0.5521	0.4120	0.3083	0.2314	0.1741	0.1314	0.0994	0.0754	0.0573	0.0437	0.0334	0.0256	0.0196	0.0151	0.0116	0.0090	0.0070	0.0054	0.0042
31	0.7346	0.5412	0.4000	0.2965	0.2204	0.1643	0.1228	0.0920	0.0691	0.0521	0.0394	0.0298	0.0226	0.0172	0.0131	0.0100	0.0077	0.0059	0.0046	0.0035
32	0.7273	0.5306	0.3883	0.2851	0.2099	0.1550	0.1147	0.0852	0.0634	0.0474	0.0355	0.0266	0.0200	0.0151	0.0114	0.0087	0.0066	0.0050	0.0038	0.0029
33	0.7201	0.5202	0.3770	0.2741	0.1999	0.1462	0.1072	0.0789	0.0582	0.0431	0.0319	0.0238	0.0177	0.0132	0.0099	0.0075	0.0056	0.0042	0.0032	0.0024
34	0.7130	0.5100	0.3660	0.2636	0.1904	0.1379	0.1002	0.0730	0.0534	0.0391	0.0288	0.0212	0.0157	0.0116	0.0086	0.0064	0.0048	0.0036	0.0027	0.0020
35	0.7059	0.5000	0.3554	0.2534	0.1813	0.1301	0.0937	0.0676	0.0490	0.0356	0.0259	0.0189	0.0139	0.0102	0.0075	0.0055	0.0041	0.0030	0.0023	0.0017
36	0.6989	0.4902	0.3450	0.2437	0.1727	0.1227	0.0875	0.0626	0.0449	0.0323	0.0234	0.0169	0.0123	0.0089	0.0065	0.0048	0.0035	0.0026	0.0019	0.0014
37	0.6920	0.4806	0.3350	0.2343	0.1644	0.1158	0.0818	0.0580	0.0412	0.0294	0.0210	0.0151	0.0109	0.0078	0.0057	0.0041	0.0030	0.0022	0.0016	0.0012
38	0.6852	0.4712	0.3252	0.2253	0.1566	0.1092	0.0765	0.0537	0.0378	0.0267	0.0190	0.0135	0.0096	0.0069	0.0049	0.0036	0.0026	0.0019	0.0013	0.0010
39	0.6784	0.4619	0.3158	0.2166	0.1491	0.1031	0.0715	0.0497	0.0347	0.0243	0.0171	0.0120	0.0085	0.0060	0.0043	0.0031	0.0022	0.0016	0.0011	0.0008
40	0.6717	0.4529	0.3066	0.2083	0.1420	0.0972	0.0668	0.0460	0.0318	0.0221	0.0154	0.0107	0.0075	0.0053	0.0037	0.0026	0.0019	0.0013	0.0010	0.0007