MGT 2251 Management Science

Exam 3

Professor Chang

November 8, 2012

Your Name (Print):_____

ID#:_____

Read each question carefully before you answer. Work at a steady pace, and you should have ample time to finish. Good Luck!!!

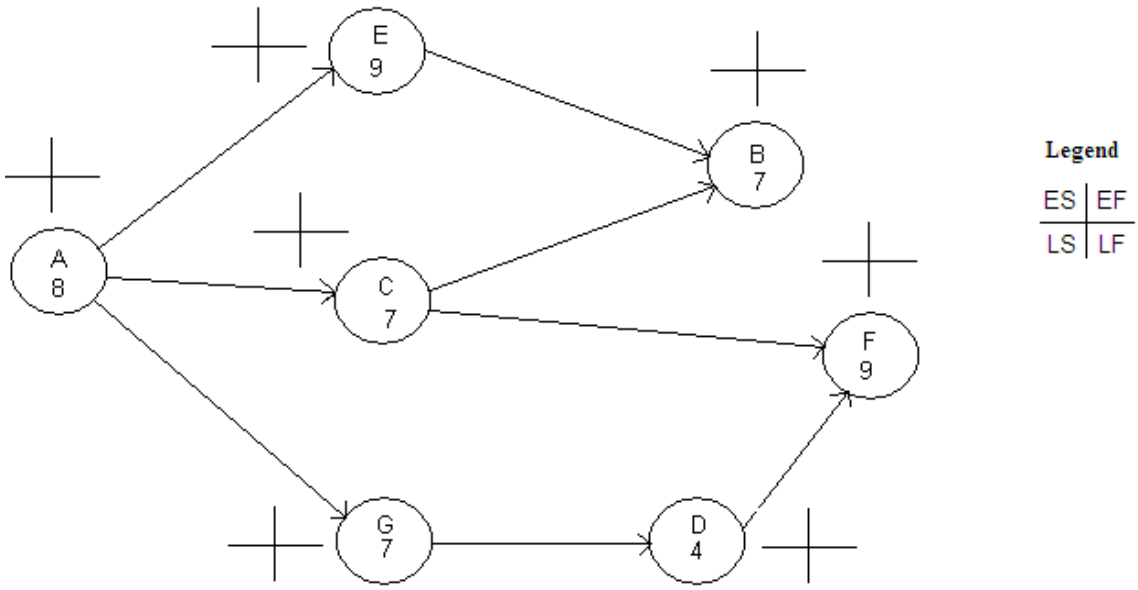
My signature ***certifies*** that I have taken this exam in accordance with the Georgia Tech honor Code.

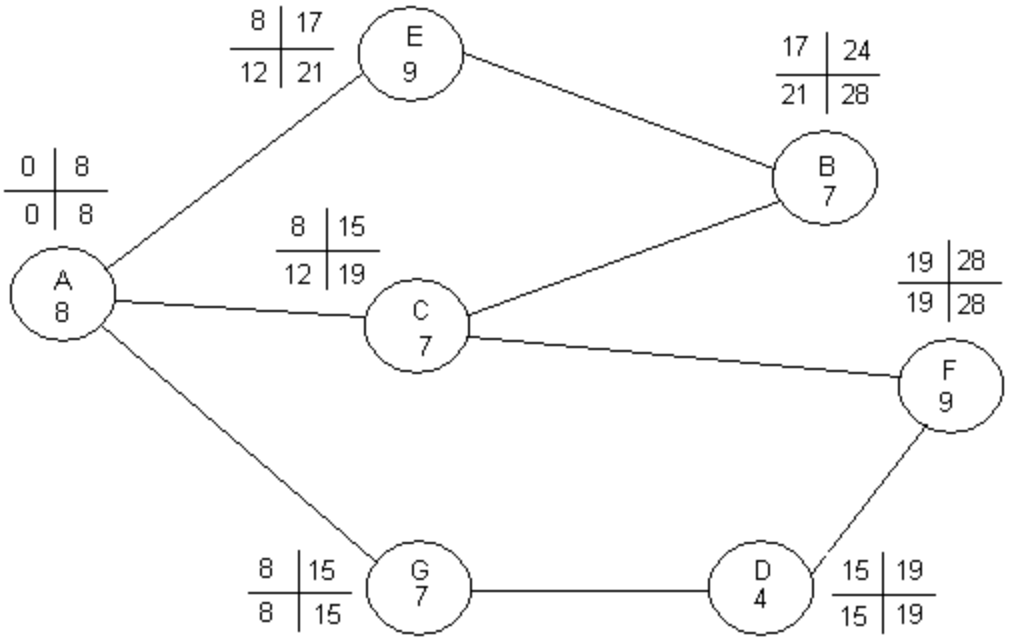
Signature_____

1. Keith Littlefield is a racecar driver on the NASCAR circuit. He has promised to participate in the Pocono 300, to be held 15 weeks from now. In order to be competitive, Keith feels he must completely modify his racecar. The following table summarizes the normal and crash costs and completion times (in weeks) of the rebuilding project activities. The predecessors of each activity are also shown in the table.

Activity Name	Normal time	Crash time	Normal cost	Crash cost	Immediate predecessor
A	8	3	$4800	$5800	-
B	7	3	3900	5100	C,E
C	7	2	5100	6600	A
D	4	2	1200	2400	G
E	9	3	3600	4800	A
F	9	3	3300	6000	C,D
G	7	2	2700	4700	A

The AON project network with normal times is drawn below.





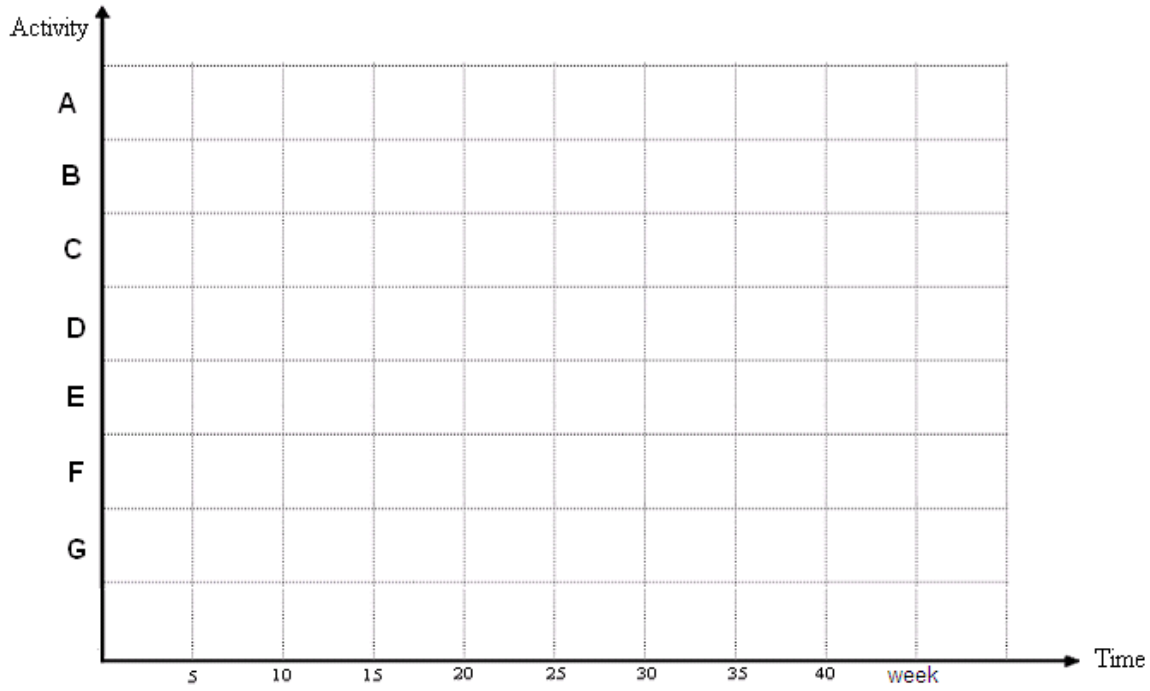
(a). Use the normal time to perform the critical path analysis, i.e., perform the forward pass and backward pass to find the earliest start time (ES), earliest finish time (EF), latest start time (LS), latest finish time (LF), and slack time for each activity. Write the ES/EF/LS/LF on the above AON diagram and write the slack times in the table below. (10 points)

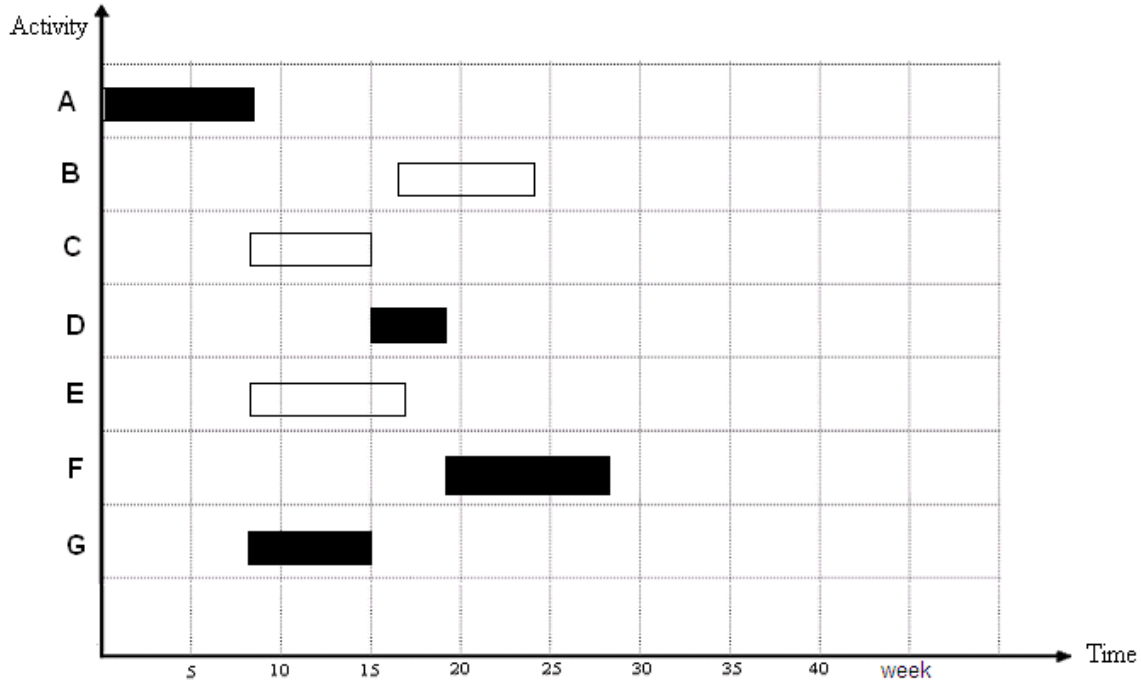
Activity	Slack Time
A	0
B	4
C	4
D	0
E	4
F	0
G	0

(b). Based on (a), determine the critical path and find the total project completion time. (3 points)

CP: A-G-D-F
Total project completion time = 28 weeks

(c). Draw the Gantt chart using the earliest times from (a)? (5 points)





(d). If the project due date is set at 15 weeks, how many weeks is the project overdue based on the above critical path analysis? If each week's delay will be penalized at $500, what is the total project cost (including normal costs and penalty costs) if the above normal times are adopted to execute the project? (3 points)

The project will be late by 13 weeks.
Total project costs = $24600+500(13) = $31100.

(e). If the project is overdue and Keith is looking to speed up the project by crashing some activity times, which activity times need to be crashed first? How much extra cost per week is needed if this activity is crashed? (2 points)

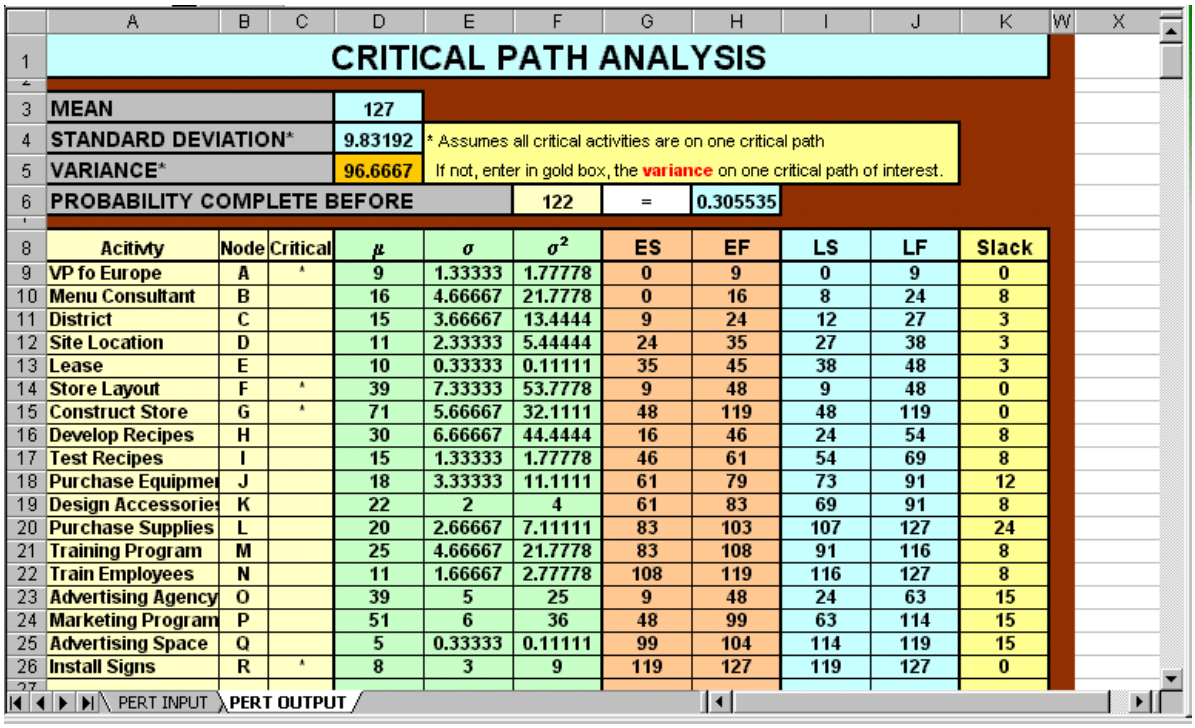
Crash activity A first.
Extra cost per week = $200.

2. Fifty-eight days ago a nervous Board of Directors of Igloo Foods, owners of the Igloo Frozen Yogurt chain, watched as the company began a program to test market its product in London, England. The target opening date for the first store was four months (122 days) from the inception of the project. If the store proves successful, Igloo plans to open up at least two dozen Igloo Frozen Yogurt stores across Great Britain and the European continent. This is the first such venture for Igloo Foods outside of the United States.

The project consists of the 18 work packages (i.e., activities) summarized in the table, together with budget information and time estimates in days.

Work Package	Immediate Predecessor	Optimistic Time	Most Likely	Pessimistic Time	Budget
A. Select vice president for Europe	—	5	9	13	$ 0
B. Select menu consultant	—	6	14	34	$ 2,000
C. Choose district for shop	A	8	13	30	$ 0
D. Make exact site selection	C	4	11	18	$ 15,000
E. Negotiate lease	D	9	10	11	$ 4,000
F. Design store layout	A	19	38	63	$ 40,000
G. Construct store	E, F	46	75	80	$260,000
H. Develop recipes	B	10	30	50	$ 15,000
I. Test recipes	H	9	16	17	$ 10,000
J. Purchase equipment	F, I	10	17	30	$150,000
K. Design Accessories	F, I	16	22	28	$ 15,000
L. Purchase supplies	K	8	22	24	$100,000
M. Develop training program	J, K	15	23	43	$ 18,000
N. Train employees	M	8	10	18	$ 7,000
O. Select advertising agency	A	30	36	60	$ 12,000
P. Develop marketing program	D, O	41	47	77	$ 90,000
Q. Purchase advertising space	P	4	5	6	$ 80,000
R. Install signs	G, Q	3	6	21	$ 26,000

A PERT/CPM analysis based on the three-time estimate approach was used to generate a schedule of work packages for the project. The following template shows the initial analysis of the critical path. It shows there is 30.55% to finish the project in 122 days.



CRITICAL PATH ANALYSIS											
MEAN			127								
STANDARD DEVIATION*			9.83192	* Assumes all critical activities are on one critical path							
VARIANCE*			96.6667	If not, enter in gold box, the variance on one critical path of interest.							
PROBABILITY COMPLETE BEFORE				122	=	0.305535					
Acitivty	Node	Critical	μ	σ	σ^2	ES	EF	LS	LF	Slack	
VP fo Europe	A	*	9	1.33333	1.77778	0	9	0	9	0	
Menu Consultant	B		16	4.66667	21.7778	0	16	8	24	8	
District	C		15	3.66667	13.4444	9	24	12	27	3	
Site Location	D		11	2.33333	5.44444	24	35	27	38	3	
Lease	E		10	0.33333	0.11111	35	45	38	48	3	
Store Layout	F	*	39	7.33333	53.7778	9	48	9	48	0	
Construct Store	G	*	71	5.66667	32.1111	48	119	48	119	0	
Develop Recipes	H		30	6.66667	44.4444	16	46	24	54	8	
Test Recipes	I		15	1.33333	1.77778	46	61	54	69	8	
Purchase Equipmer	J		18	3.33333	11.1111	61	79	73	91	12	
Design Accessories	K		22	2	4	61	83	69	91	8	
Purchase Supplies	L		20	2.66667	7.11111	83	103	107	127	24	
Training Program	M		25	4.66667	21.7778	83	108	91	116	8	
Train Employees	N		11	1.66667	2.77778	108	119	116	127	8	
Advertising Agency	O		39	5	25	9	48	24	63	15	
Marketing Program	P		51	6	36	48	99	63	114	15	
Advertising Space	Q		5	0.33333	0.11111	99	104	114	119	15	
Install Signs	R	*	8	3	9	119	127	119	127	0	

PERT INPUT | PERT OUTPUT

(a). Using the information in the above table, what is the chance to finish the project in (≤) 130 days? (3 points)

P(X≤130)=P(Z≤ (130-127)/9.83192)=P(Z≤0.31)=0.6217

(b). Using the information in the above table, what is the chance to finish the project over (>) 135 days? (3 points)

P(X>135)=P(Z>(135-127)/9.83192)=P(Z>0.81)=1.0-0.7910=0.209

(c). Using the information in the above table, if the company is to be 99% sure to finish the project, what is the target due date (D) should be? (3 points)

P(X≤D)=0.99, Z=2.33
D=127+2.33*9.83192=149.9 days or to set the deadline at 150 days.

Now, 58 days into the project, the Board of Directors has received the following project status report. The activity completion and value analysis is provided in the following progress report table. However, the detail actual cost (expenditure) for each work package is not available but the total expenditure is estimated at $255,000.

Date: Day 58 Actual Total Expenditure (Cost) to Date: $255,000

Progress Report

Work Package	Percent Complete	Budget	Value
A. Select vice president for Europe	100%	$0	$0
B. Select menu consultant	100%	$2,000	$2,000
C. Choose district for shop	100%	$0	$0
D. Make exact site selection	100%	$15,000	$15,000
E. Negotiate lease	50%	$4,000	$2,000
F. Design store layout	100%	$40,000	$40,000
G. Construct store	0%	$260,000	$0
H. Develop recipes	100%	$15,000	$15,000
I. Test recipes	100%	$10,000	$10,000
J. Purchase equipment	75%	$150,000	$112,500
K. Design accessories	25%	$15,000	$3,750
L. Purchase supplies	0%	$100,000	$0
M. Develop training program	0%	$18,000	$0
N. Train employees	0%	$7,000	$0
O. Select advertising agency	50%	$12,000	$6,000
P. Develop marketing program	0%	$90,000	$0
Q. Purchase advertising space	0%	$80,000	$0
R. Install signs	0%	$26,000	$0

(d). Based on the above progress report, what is the total value of the project at day 58? Is the project actual cost at day 58 under run or overrun and by how much? (3 points)

The total value of the project = $206,250.
It is less than the actual expenditure $255,000. Therefore, it is overrun
By 255,000-206,250=$48,750.

At day 58 (i.e., 64 days away from the target 122 days), based on the above project status report, the new critical path analysis is shown below. The chance to meet the deadline at 122 days is 0.000910.

CRITICAL PATH ANALYSIS

MEAN	84	
STANDARD DEVIATION*	6.41396	* Assumes all critical activities are on one critical path
VARIANCE*	41.13889	If not, enter in gold box, the variance on one critical path of interest.
PROBABILITY COMPLETE BEFORE	64	= 0.000910

Acitivty	Node	Critical	μ	σ	σ^2	ES	EF	LS	LF	Slack
VP fo Europe	A	*	0	0	0	0	0	0	4.14E-11	0
Menu Consultant	B		0	0	0	0	0	31.5	31.5	31.5
District	C	*	0	0	0	0	0	0	2.57E-11	0
Site Location	D	*	0	0	0	0	1.14E-12	0	2.09E-11	0
Lease	E	*	5	0.166667	0.027778	0	5	0	5	0
Store Layout	F		0	0	0	0	0	5	5	5
Construct Store	G	*	71	5.666667	32.11111	5	76	5	76	0
Develop Recipes	H		0	0	0	0	0	31.5	31.5	31.5
Test Recipes	I		0	0	0	0	2.27E-12	31.5	31.5	31.5
Purchase Equipmer	J		4.5	0.833333	0.694444	0	4.5	43.5	48	43.5
Design Accessories	K		16.5	1.5	2.25	0	16.5	31.5	48	31.5
Purchase Supplies	L		20	2.666667	7.111111	16.5	36.5	64	84	47.5
Training Program	M		25	4.666667	21.77778	16.5	41.5	48	73	31.5
Train Employees	N		11	1.666667	2.777778	41.5	52.5	73	84	31.5
Advertising Agency	O		19.5	2.5	6.25	0	19.5	0.5	20	0.5
Marketing Program	P		51	6	36	19.5	70.5	20	71	0.5
Advertising Space	Q		5	0.333333	0.111111	70.5	75.5	71	76	0.5
Install Signs	R	*	8	3	9	76	84	76	84	0

(e). Based on the above revised critical path analysis at day 58, the chance to meet the deadline by 122 days (64 days away) is 0.000910. The Igloo management decides to delay the opening day by 35 days, which extends the deadline to be 99 days from day 58. How much will this improve the chance to finish the project with the new deadline as compared to the old deadline? (The new mean and standard deviation are shown on the above table.) (3 points)

P(X<=99)=P(Z<=(99-84)/6.41396)=P(Z<=2.34)=0.9904.
This increases the chance of meeting deadline by 0.9904-0.000910=0.98949 -→ 99%.

3. The following table shows the activity information for the Southwestern University Stadium Construction Project.

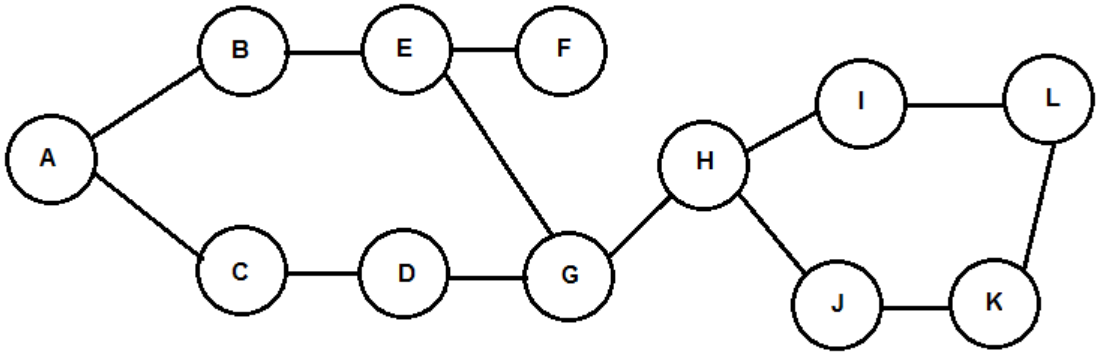
TABLE 12.11. Southwestern University Stadium Project.

			TIME ESTIMATES (DAYS)		
ACTIVITY	DESCRIPTION	PREDECESSORS	OPTIMISTIC	MOST LIKELY	PESSIMISTIC
A	Bonding, insurance, tax structuring	—	20	30	40
B	Foundation concrete footings for boxes	A	20	65	80
C	Upgrading skyboxes, stadium seating	A	50	60	100
D	Upgrading walkways, stairwells, elevators	C	30	50	100

E	Interior wiring, lathes	B	25	30	35
F	Inspection approvals	E	1	1	1
G	Plumbing	D, E	25	30	35
H	Painting	G	10	20	30
I	Hardware/air conditioning/ metal workings	H	20	25	60
J	Tile/carpeting/windows	H	8	10	12
K	Inspection	J	1	1	1
L	Final detail work/ cleanup	I, K	20	25	60

(a). Draw the project network in AON format. Do not write the activity times. (5 points)

AON network for the project:



(b). What is the average time and standard deviation time for activity A? (3 points)

Average time for activity A = (20+(4)*30+40)/6=30
Standard deviation time for activity A = (40-20)/6=3.3333.

4. Southern Homes is a home builder located in a suburb of Atlanta. The company must decide whether to leave its model homes unfurnished, furnish them with minimal accessories, or completely furnish them using a custom decorator. The new-home market is generally quite profitable, but Southern is suffering cash flow problems. The following table gives the profit per lot for Southern Homes based on how Southern furnishes its model homes and the overall demand for housing in Atlanta market.

Model Home Furnishing Alternative	Housing Market in Atlanta			
	Weak	Moderate	Strong	Very Strong
Unfurnished	-$1,500	$1,000	$2,000	$3,000
Minimal Accessories	-$4,000	$500	$3,500	$6,000
Custom Decorated	-$7,000	$1,500	$2,500	$9,500

(a). What is the best decision if Southern management is very optimistic and aggressive (i.e., uses the maximax criterion)? What is the decision payoff value? (3 points)

Best Decision by Maximax: Custom Decorated.

Decision Payoff = $9,500.

(b). What is the best decision if Southern management is very conservative and pessimistic (i.e., uses the maximin criterion)? What is the decision payoff value? (3 points)

Best Decision by Maximin: Unfurnished model homes.
Decision Payoff = -$1,500.

(c). Fill in the regret values for Southern management in the following table. (5 points)

Model Home Furnishing Alternative	Housing Market in Atlanta			
	Weak	Moderate	Strong	Very Strong
Unfurnished				
Minimal Accessories				
Custom Decorated				

Model Home Furnishing Alternative	Housing Market in Atlanta			
	Weak	Moderate	Strong	Very Strong
Unfurnished	$0	$500	$1,500	$6,500
Minimal Accessories	$2,500	$1,000	$0	$3,500
Custom Decorated	$5,500	$0	$1,000	$0

(d). What is the best decision if Southern management wishes to minimize the firm's maximum regret (i.e., uses the minimax regret criterion)? What is the decision regret value? (3 points)

Best Decision by Minimax regret: Minimal Accessories.
Decision Regret = $3,500.

(e). Based on past experience, suppose Southern management believes that the following probabilities hold for the housing market in Atlanta:

P(Weak) = 0.20
P(Moderate) = 0.40
P(Strong) = 0.30
P(Very Strong) = 0.10

The following payoff table has the probabilities of market situations.

Model Home Furnishing Alternative	Housing Market in Atlanta			
	Weak	Moderate	Strong	Very Strong
Unfurnished	-$1,500	$1,000	$2,000	$3,000
Minimal Accessories	-$4,000	$500	$3,500	$6,000
Custom Decorated	-$7,000	$1,500	$2,500	$9,500
Probability	0.2	0.4	0.3	0.1

What is the best decision if Southern management uses the expected money value criterion? What is the expected payoff value (expected money value, EMV)? (5 points)

EMV(Unfurnished)=.2(-1,500)+.4(1,000)+.3(2,000)+.1(3,000)=$1,000
EMV(Minimal Accessories)=.2(-4,000)+.4(500)+.3(3500)+.1(6000)=$1,050
EMV(Custom Decorated)=.2(-7000)+.4(1500)+.3(2500)+.1(9500)=$900
Best Decision by Expected Value: Minimal Accessories.
Best EMV = $1,050.

(f). If someone has a crystal ball which tells the housing market is going to be strong for sure, what is the value of this perfect information? (3 points)

Payoff (Strong)= $3, 500 with Model homes furnished with minimal accessories.
VPI(Strong)=3500-1050=$2450.

(g). Based on the probabilities given above, what is the expected value of perfect information (EVPI) about the housing market if it is available? (5 points)

EVwPI=.2(-1500)+.4(1500)+.3(3500)+.1(9500)=$2300
EVPI=EVwPI- Best EMV =2300-1050=$1,250.

5. Pickens Exploration Company has been offered a lease to drill for oil on a particular piece of property. While oil has been found on nearby land, there are no assurances that Pickens will be successful in finding oil. The company feels that it will strike a major find, an average find, or a dry hole. A major find can be sold to an oil company for $6 million, while an average find will only bring in $2 million (also will be sold to an oil company). A dry hole will cost the company $80,000 to cap (definitely no one will buy it).

The cost of the lease is $400,000 plus 20% of the revenue if the oil well is sold to an oil company. Pickens estimates that it can drill a well at a cost of $160,000. Without further testing, Pickens' geologist estimates based on historical evidence that there is a 5% chance that the well will be a major find, a 45% chance that it will be an average find, and a 50% chance that it will be a dry hole.

In order to get a better estimate of the probability of finding oil in the well, the geologist is contemplating performing either a geologic or a seismic test. A geologic test will cost $20,000. From the past experience, if the test predicts oil, the geologist believes that the following conditional probabilities hold:

P(test predicts oil/major find) = .75
P(test predicts oil/average find) = .50
P(test predicts oil/dry hole) = .20

Instead of the geologic test, the firm can perform the more detailed seismic test, which costs $50,000. From the past experience, if this test predicts oil, the geologist believes that the following conditional probabilities hold:

P(test predicts oil/major find) = .90
P(test predicts oil/average find) = .60
P(test predicts oil/dry hole) = .10

Pickens can do the testing prior to deciding whether or not to procure the lease and drill. If Pickens gets a prediction of oil from either the geologic or seismic tests, it can sell a half-interest in the well to a Dallas investor for $800,000. In this case Pickens will be responsible for any and all losses on the well should it lose money, but will split profits on the well equally with the investor.

To help making the decision, the company computes the payoffs before any test for the results of major find, average find, and dry hole.

Payoff:
MF = 6*0.8-0.4-0.16=4.24M;
AF = 2*0.8-0.4-0.16=1.04M;
DH = -.4-.16-.08= -0.64M (all in millions)

After the geologic test, if the test predicts oil, the payoffs for selling half-interest to the Dallas investor and not selling for the results of major find, average find, and dry hole are computed below.

Payoffs with selling ½ interest: MF=(4.24-0.02)/2+0.8=2.91M;
AF=(1.04-0.02)/2+0.8=1.31;
DH=-0.64-0.02+0.8= 0.14M
Payoffs with not selling ½ interest: MF=4.24-0.02=4.22M;
AF=1.04-0.02=1.02;
DH=-0.64-0.02= -0.66M

After the geologic test, if the test predicts no oil, the payoffs for the results of major find, average find, and dry hole are computed below.

Payoffs: MF=4.24-0.02=4.22M;
AF=1.04-0.02=1.02;
DH=-0.64-0.02= -0.66M

After the seismic test, if the test predicts oil, the payoffs for selling half-interest to the Dallas investor and not selling for the results of major find, average find, and dry hole are computed below.

Payoffs with selling ½ interest: MF=(4.24-0.05)/2+0.8=2.895M;
AF=(1.04-0.05)/2+0.8=1.295;
DH=-0.64-0.05+0.8= 0.11M
Payoffs with not selling ½ interest: MF=4.24-0.05=4.19M;
AF=1.04-0.05=0.99;
DH=-0.64-0.05= -0.69M

After the seismic test, if the test predicts no oil, the payoffs for the results of major find, average find, and dry hole are computed below.

Payoffs: MF=4.24-0.05=4.19M;
AF=1.04-0.05=0.99;
DH=-0.64-0.05= -0.69M

With the help of a convenient Excel template, the posterior (revised) probability analysis for the geologic test is shown in the following table. (PO: predict oil; PNO: predict no oil)

State of nature(SN)	P(SN)	P(I/SN)		P(I,SN)		P(SN/I)	
		PO	PNO	PO	PNO	PO	PNO
MF (major find)	.05	.75	.25	0.0375	0.0125	0.103	0.020
AF (average find)	.45	.50	.50	0.225	0.225	0.621	0.353
DH (dry hole)	.50	.20	.80	0.1	0.4	0.276	0.627
			P(I)=	0.3625	0.6375		

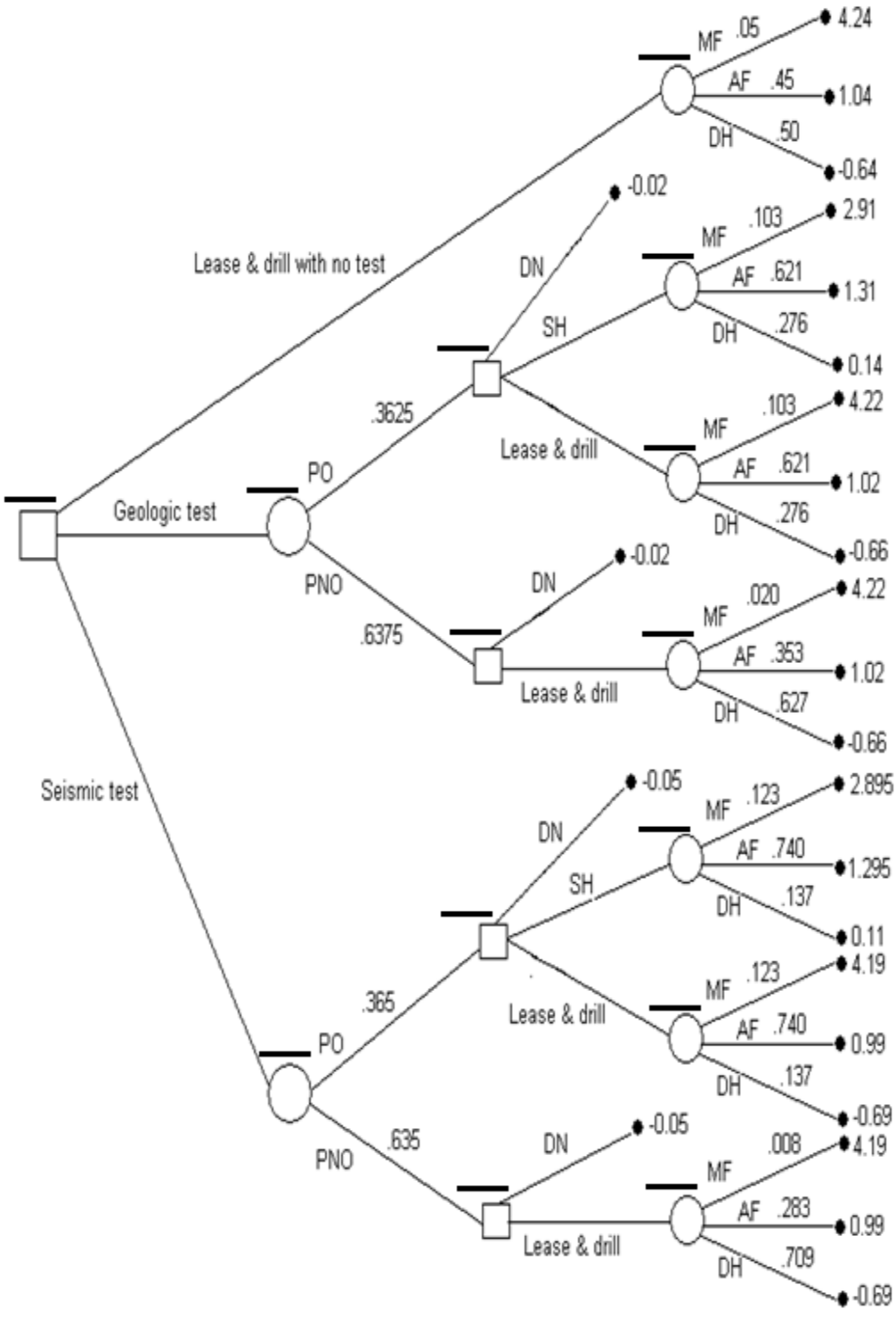
Similarly with the help of the Excel template, the posterior (revised) probability analysis for the seismic test is shown in the following table.

State of nature(SN)	P(SN)	P(I/SN)		P(I,SN)		P(SN/I)	
		PO	PNO	PO	PNO	PO	PNO
MF (major find)	.05	.90	.10	0.045	0.005	0.123	0.008
AF (average find)	.45	.60	.40	0.27	0.18	0.740	0.283
DH (dry hole)	.50	.10	.90	0.05	0.45	0.137	0.709
			P(I)=	0.365	0.635		

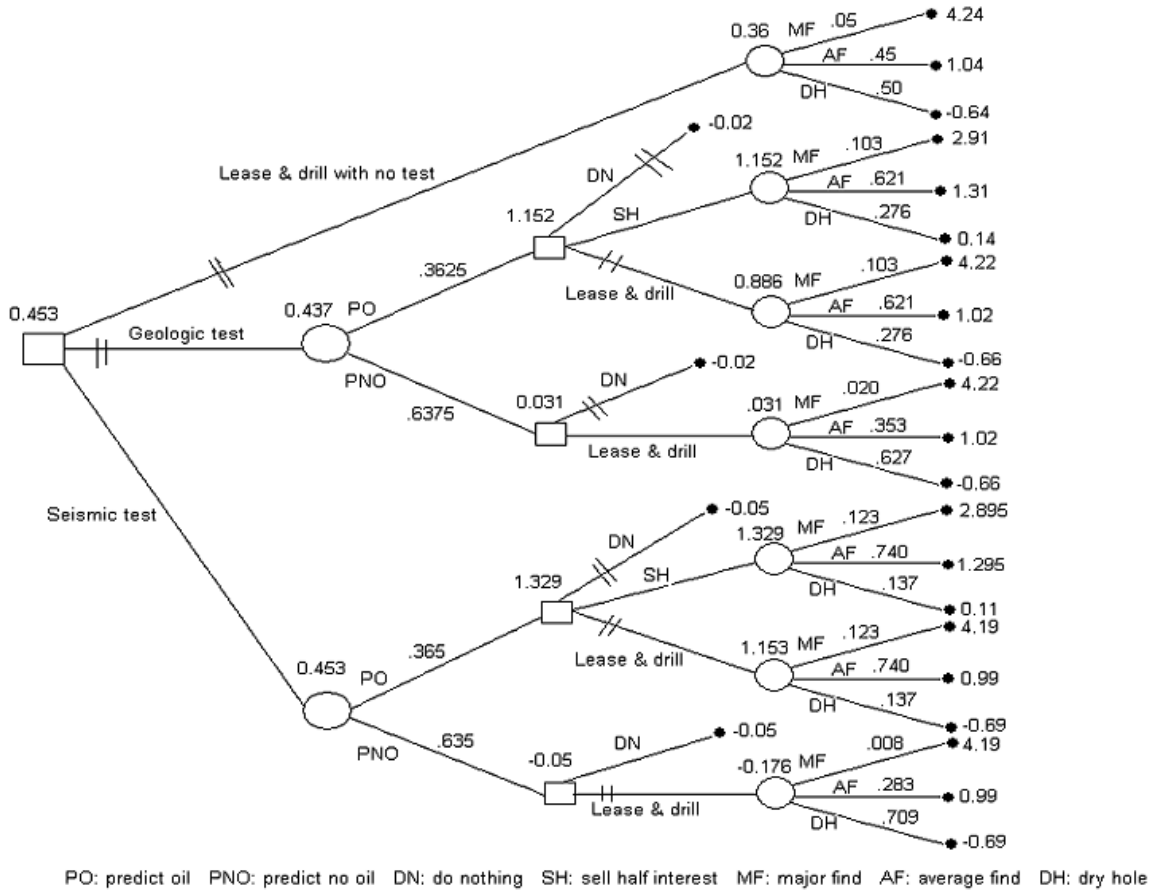
(a). From the above revised probability tables, what is the probability of an average finding if the geologic test predicts no oil, i.e., P(average find/test predicts no oil)? What is the probability of a major finding if the seismic test predicts oil, i.e., P(major find/test predicts oil)? (2 points)

P(AF/PNO)=0.353; P(MF/PO)=0.123

(b). The following decision tree represents the complete decision situation. The payoffs and the related probabilities are included. Perform the decision tree analysis. That is to complete the computation of the expected values for all chance nodes and the choice of the best decisions for all decision nodes. (15 points)



PO: predict oil PNO: predict no oil DN: do nothing SH: sell half interest MF: major find AF: average find DH: dry hole



(c). What optimal decision(s) and sequence should Pickens take and what is the expected payoff? (4 points)

Do Seismic Test, if test predicts oil then sell half the interest and drill; if test predicts no oil then do not drill.
The final and overall expected payoff = EV (ST)= 0.453M

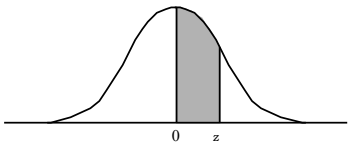
(d). What is the value of the geologic test? (3 points)

EVSI(GT)=0.437-0.36+0.02= 0.097M

(e). What is the value of the seismic test? (3 points)

EVSI(ST)=0.453-0.36+0.05= 0.143M

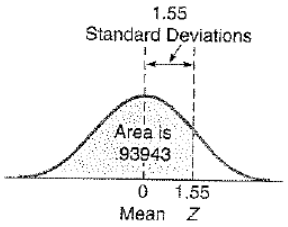
Areas of the Standard Normal Distribution



An entry in the table is the proportion under the entire curve which is between Z = 0 and a positive value of z. Areas for negative values of z are obtained by symmetry.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

APPENDIX A: AREAS UNDER THE STANDARD NORMAL CURVE



Example: To find the area under the normal curve, you must know how many standard deviations that point is to the right of the mean. Then the area under the normal curve can be read directly from the normal table. For example, the total area under the normal curve for a point that is 1.55 standard deviations to the right of the mean is .93943.

	00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73536	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97784	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900
3.1	.99903	.99906	.99910	.99913	.99916	.99918	.99921	.99924	.99926	.99929
3.2	.99931	.99934	.99936	.99938	.99940	.99942	.99944	.99946	.99948	.99950

	00	.01	.02	.03	.04	.05	.06	.07	.08	.09
3.3	.99952	.99953	.99955	.99957	.99958	.99960	.99961	.99962	.99964	.99965
3.4	.99966	.99968	.99969	.99970	.99971	.99972	.99973	.99974	.99975	.99976
3.5	.99977	.99978	.99978	.99979	.99980	.99981	.99981	.99982	.99983	.99983
3.6	.99984	.99985	.99985	.99986	.99986	.99987	.99987	.99998	.99988	.99989
3.7	.99989	.99990	.99990	.99990	.99991	.99991	.99992	.99992	.99992	.99992
3.8	.99993	.99993	.99993	.99994	.99994	.99994	.99994	.99995	.99995	.99995
3.9	.99995	.99995	.99996	.99996	.99996	.99996	.99996	.99996	.99997	.99997