

- 1 Problem 1: No analytic solution for product of Normal and Log-Normal random variables.
- 2 Opportunity Product of two log-normals is a log-normal. Log-normal can approximation a normal
- 3 Situation Normal defined by mean & standard deviation. Log-normal defined by mean & median
- 4 Problem 2: No analytic solution for median of log-normal given mean and **standard deviation**.
- 5 Opportunity There is an analytic solution for **std. deviation**, given mean and median of log-normal.
- 6 Solution: Implement manual "goal seek" to find median given mean and **std. deviation**

8 **Instructions for manual entries:**

- 9 Step 1 #1. Frequency: Enter mean (C18) and slightly smaller median (C17).
- 10 Step 2 #1. Frequency: Adjust Median (C17) until resulting standard deviation (C20) is OK.
- 11 Step 3 #2: Severity: Enter median (C25) and mean (C26). If Std.Dev is given, do same as above.
- 12 Step 4 #4: Distribution of Losses. Enter desired percentiles (H41:H43)

14	B	C	D	E	F	G	H
----	---	---	---	---	---	---	---

15	#1. Frequency Distribution (# / unit time)				Underlying math statistics		
16		Real-world values					
17	1Median	99.5	Manual/Adjust	mu	4.600	=LN(C17)	
18	1Mean	100.0	Manual	mu+S ² /2	4.605	=LN(C18)	
19				Sigma ²	0.010	=2*(G17-G16)	
20	1StdDev	10.0		Sigma	0.100	=SQRT(G18)	
21	1Mode	98.5					

22	B	C	D	E	F	G	H
----	---	---	---	---	---	---	---

23	#2. Loss Severity Distribution (\$)				Underlying math statistics		
24		Real-world values					
25	2Median	50	Manual	mu	3.912	=LN(C25)	
26	2Mean	100	Manual	mu+S ² /2	4.605	=LN(C26)	
27				Sigma ²	1.386	=2*(G25-G24)	
28	2Mode	13		Sigma	1.177	=SQRT(G26)	
29	2StdDev	173					

30	B	C	D	E	F	G	H
----	---	---	---	---	---	---	---

31	#3. Distribution of Total Losses (\$/year): Product of Frequency and Severity						
32	Assume frequency and severity distributions are not correlated.						
33		Real-world values			Underlying math statistics		
34	3Median	4,975	=EXP(G34)	mu	8.512	=G24+G16	
35	3Mean	10,000	=EXP(G34+G35/2)	Sigma ²	1.396	=G18+G26	
36	3Mode	1,526	=EXP(G34-G36)	Sigma	1.182	=SQRT(G35)	
37	3Std Dev	17,436	=C35*SQRT(EXP(G35)-1)				

38	B	C	D	E	F	G	H
----	---	---	---	---	---	---	---

39	#4. Total Losses Below Percentile				Enter Percentiles Manually		
40	Expected	\$10,000	=C18*C26	Percentile Total Loss Below			
41	Percentile	72.3%		90%	\$22,619		
42			=LOGNORM.DIST(C40,G34,G36,1)	95%	\$34,747		
43	Percentile	Total Loss Below		99%	\$77,741		
44		50%	\$4,975	=LOGNORM.INV(B44,\$G\$34,\$G\$36)			

0.01	318
0.05	712
0.10	1,094
0.15	1,462
0.20	1,840
0.25	2,242
0.30	2,677
0.35	3,155
0.40	3,688
0.45	4,288
0.50	4,975
0.55	5,771
0.60	6,711
0.65	7,844
0.70	9,245
0.75	11,039
0.80	13,449
0.85	16,931
0.90	22,619
0.95	34,747
0.99	77,741
####	191,718
####	403,040
####	768,219
####	1,368,342

