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## **The Role of Conditional Probabilities in Risk Assessment**

Richard R. Joss  
Resource Actuary (Retired)  
Towers Watson

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### **Sample of Independent Probabilities The Toss of a Single Die**

<u>Number</u>	<u>Probability</u>
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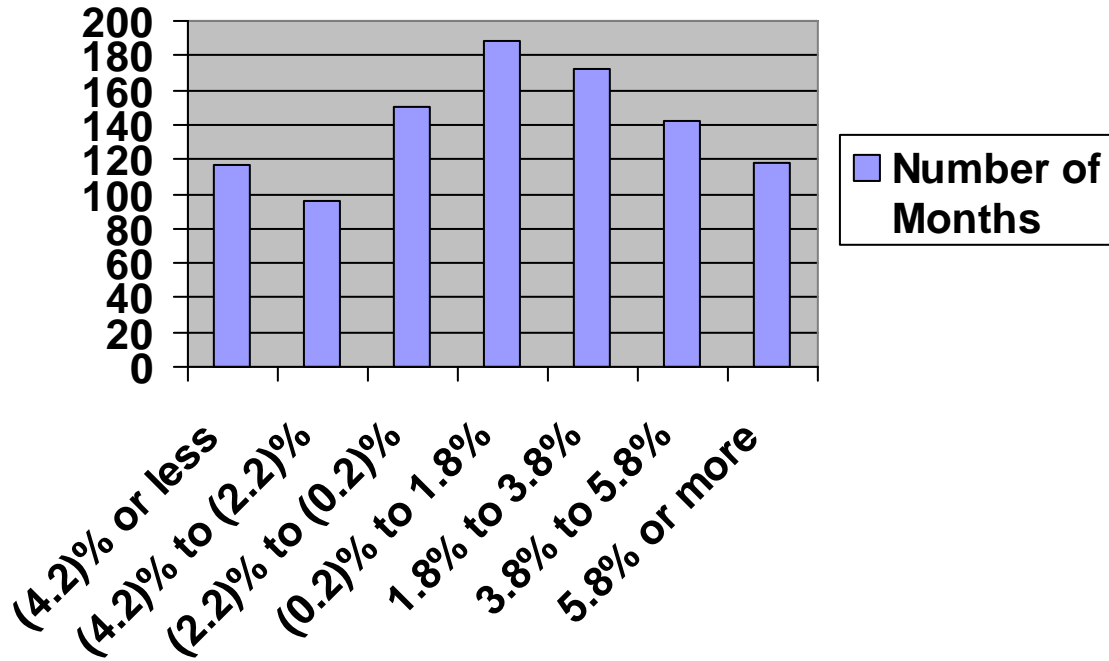
1	1/6
2	1/6
3	1/6
4	1/6
5	1/6
6	1/6

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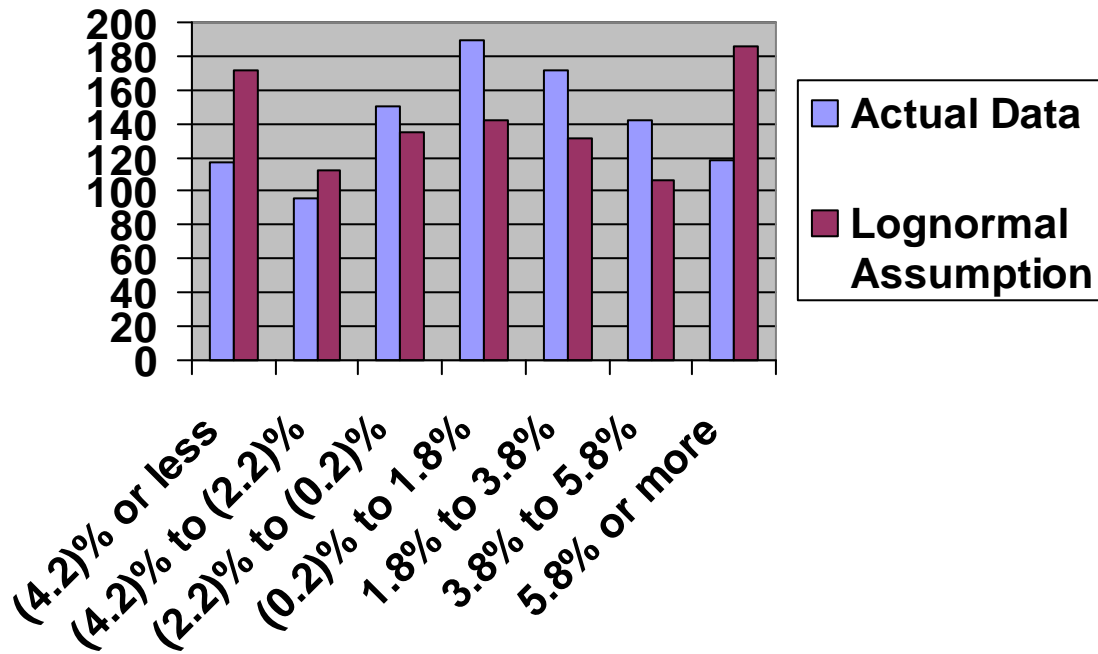
### **Sample of Conditional Probabilities Toss of Single Die Given the Condition that Sum of Two Dice is 8**

<u>Number Seen</u>	<u>Independent Probability</u>	<u>Conditional Probability</u>
1	1/6	0
2	1/6	1/5
3	1/6	1/5
4	1/6	1/5
5	1/6	1/5
6	1/6	1/5

## Distribution of Monthly Large Company Stock Returns

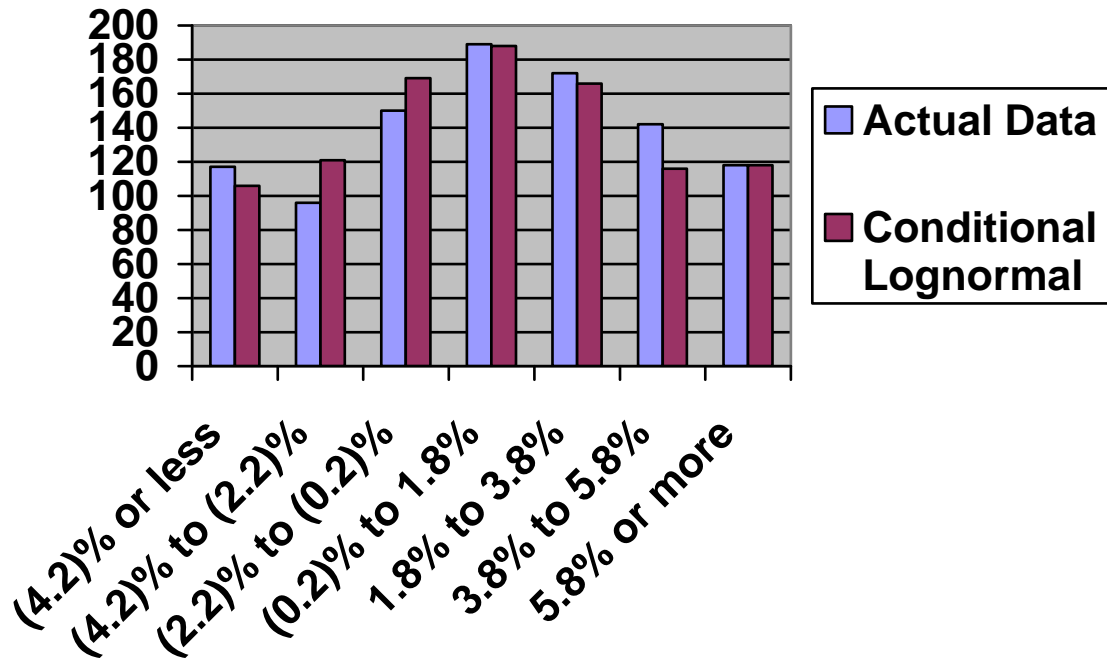


## Distribution of Monthly Large Company Stock Returns Compared With Lognormal Assumption



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## Distribution of Monthly Large Company Stock Returns Compared With Conditional Lognormal Assumption



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### Lognormal Distribution Comparison

<u>Basis</u>	<u>Expected Value</u>
Independent	12.26%
Conditional	10.36%

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## **Time Magazine (10/19/2009)**

**“When Boston College’s Munnell looked at the returns 401(k)s have actually produced compared with projections, the difference was sobering. The average 55-to-64-year old should have a 401(k) balance of \$320,000. In fact, at the end of 2007, the average 401(k) of a near retiree held just \$78,000 – and that was before the market meltdown.”**

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## **Investment Return Comparison Defined Benefit Plans And 401(K) Plans 1990 – 2006**

<b><u>Plan Type</u></b>	<b><u>Average Return</u></b>
<b>Defined Benefit</b>	<b>9.5%</b>
<b>401(K)</b>	<b>8.4%</b>

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## **Summary**

**When Using Conditional Data  
Consider Using a Conditional  
Probability Density Function  
For Data Analysis**

**It Makes a Big Difference!**

