

# Chapter 8, Problem 8

## Smart Textiles: Variable Volatility

(Effect of 2nd Volatility Factor)

### Input Data

Present value of future cash flows	<b>\$200</b>	million
Volatility (first 2 years)	<b>20%</b>	annual
Risk-free rate of return	<b>5%</b>	annual
Time to expiration	<b>4</b>	years
Volatility (last 2 years)	<b>25%</b>	annual
Time step	<b>1</b>	year(s)
Cost of investment	<b>\$250</b>	million

### Results

NPV	-\$50
ROV	\$32
Value added	\$82

### Calculated Parameters

#### First Two Years

Up factor ( $u$ )	1.221
Down factor ( $d$ )	0.819
Risk-neutral probability ( $p$ )	0.577

#### Second Two Years

Up factor ( $u$ )	1.284
Down factor ( $d$ )	0.779
Risk-neutral probability ( $p$ )	0.539

### Asset Valuation Lattice

Time period	0	1	2	3	4
				<b>\$383</b>	<b>\$492</b>
					<b>\$298</b>
				<b>\$232</b>	<b>\$298</b>
					<b>\$181</b>
Valuation of underlying asset	\$200	\$244	<b>\$298</b>	<b>\$257</b>	<b>\$330</b>
		\$164	<b>\$200</b>		<b>\$200</b>
			<b>\$134</b>	<b>\$156</b>	<b>\$200</b>
					<b>\$121</b>
				<b>\$172</b>	<b>\$221</b>
					<b>\$134</b>
				<b>\$104</b>	<b>\$134</b>
					<b>\$81</b>



## Option Valuation Lattice

Time period	0	1	2	3	\$4
				\$145	\$242
					\$48
				\$25	\$48
					\$0
Valuation of option	\$32	\$49	\$75	\$41	\$80
		\$12	\$21		\$0
			\$0	\$0	\$0
					\$0
				\$0	\$0
					\$0
				\$0	\$0
					\$0



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### Input Data

Present value of future cash flows	\$200	million
Volatility (first 2 years)	20%	annual
Risk-free rate of return	5%	annual
Time to expiration	4	years
Volatility (last 2 years)	35%	annual
Time step	1	year(s)
Cost of investment	\$250	million

### Results

NPV	-\$50
ROV	\$41
Value added	\$91

### Calculated Parameters

#### First Two Years

Up factor ( $u$ )	1.221
Down factor ( $d$ )	0.819
Risk-neutral probability ( $p$ )	0.577

#### Second Two Years

Up factor ( $u$ )	1.419
Down factor ( $d$ )	0.705
Risk-neutral probability ( $p$ )	0.485

### Asset Valuation Lattice

Time period	0	1	2	3	4
				\$423	\$601
					\$298
				\$210	\$298
					\$148
Valuation of underlying asset	\$200	\$244	\$298	\$284	\$403
		\$164	\$200		\$200
			\$134	\$141	\$200
					\$99
				\$190	\$270
					\$134
				\$94	\$134
					\$67



## Option Valuation Lattice

Time period	0	1	2	\$3	\$4
				\$186	\$351
					\$48
				\$22	\$48
					\$0
Valuation of option	\$41	\$60	\$86	\$70	\$153
		\$20	\$33		\$0
			\$4	\$0	\$0
					\$0
				\$9	\$20
					\$0
				\$0	\$0
					\$0



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### Input Data

Present value of future cash flows	\$200	million
Volatility (first 2 years)	20%	annual
Risk-free rate of return	5%	annual
Time to expiration	4	years
Volatility (last 2 years)	40%	annual
Time step	1	year(s)
Cost of investment	\$250	million

### Results

NPV	-\$50
ROV	\$46
Value added	\$96

### Calculated Parameters

#### First Two Years

Up factor ( $u$ )	1.221
Down factor ( $d$ )	0.819
Risk-neutral probability ( $p$ )	0.577

#### Second Two Years

Up factor ( $u$ )	1.492
Down factor ( $d$ )	0.670
Risk-neutral probability ( $p$ )	0.464

### Asset Valuation Lattice

Time period	0	1	2	3	4
				\$445	\$664
					\$298
				\$200	\$298
					\$134
Valuation of underlying asset	\$200	\$244	\$298	\$298	\$445
		\$164	\$200		\$200
			\$134	\$134	\$200
					\$90
				\$200	\$298
					\$134
				\$90	\$134
					\$60



## Option Valuation Lattice

Time period	0	1	\$2	\$3	\$4
				\$207	\$414
					\$48
				\$21	\$48
					\$0
Valuation of option	\$46	\$65	\$91	\$86	\$195
		\$25	\$38		\$0
			\$9	\$0	\$0
					\$0
				\$21	\$48
					\$0
				\$0	\$0
					\$0

