

Derivative-Based Risk Management Project



FINC 556

**DERIVATIVES AND FINANCIAL MARKETS
PROF. BODURTHA**

2/26/2009

Project Group Members

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Definition of Business Problem

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Our team is taking the position of the long/short portion Georgetown University Endowment. After a suboptimal 2008 combined with dampened optimism for 2009, we have reduced our equity index-based position to 20% (roughly \$200,000,000) of total assets on book.

These funds are 100% allocated to an S&P 500 Index Fund. Therefore, Georgetown University is “long” the S&P 500, as an increase in the value of the S&P 500 fund is favorable for our investment.

Exposure: $+F_{SP}$ \$200,000,000

Loss Limit: We want only an 5/100 (5%) chance of losing more than 10% of our exposure (\$20,000,000).

Futures Market Situation and Evolution

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- Each contract constitutes 250 units of S&P 500 futures. At the current price of 861.9 (on 2/9/09), each contract represents 250 x 861.9 = \$215,475.
- Therefore our total long exposure is:

$$\text{SP} -- \frac{\$200,000,000}{(250 * 861.9)} = +929 \text{ Contracts}$$
 (Actual number 928.182)

Underlying – S&P 500 (June)	Mar	Jun	Sep	Dec
Current date (2/9/09) Settle (Close) Price	865.1	861.9	859.7	857.2
Actual Maturity date (Check web, & may need to discuss)	3/20	6/19	9/18	12/18
Symbol	SPH9	SPM9	SPU9	SPZ9
Subsequent date (2/13/09) Settle (Close) Price	820.6	816.90	814.40	811.90
Subsequent (next maturity) date mark-to-market	-44.5	-45	-45.3	-45.3

Brief Overview – Market Outlook

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- The markets in aggregate have demonstrated unparalleled high volatility since late summer 2007 with the implosion of the United States subprime mortgage sector and its epidemic spread across the entire economy. In the past four months alone, the Volatility Index (VIX) has peaked at over 80 with the S&P 500 Index itself hemorrhaging from roughly 1000 to the mid 750s over the same period. However, despite the index avalanche, recent metrics have indicated that S&P 500 volatility as measured by VIX has tempered, with values “plateauing” in the mid to high 40s.
- A fundamental perspective of the S&P 500 with current PE ratio of 16-17 (ten-year cyclically adjusted PE ratio of 14) may indicate the index is presently undervalued. However, we anticipate that further depressed first quarter 2009 earnings will temporarily bolster the PE ratio to approximately 25 – closer to recent high levels and supportive of our ultimate forecast that the market has further room to fall.

Brief Overview – Market Outlook (cont'd)

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- The forecast.org view from February to June 2009 also suggests a bearsish S&P 500 outlook but with diminishing changes month to month – arriving at an approximate floor in low 700s.
(Please see table on slide 8)
- **Given the above, our forecast through June 2009 is consequently that the price of the S&P 500 Index will continue to decline to 700 vs the 714 implied forecast (or 861.9 for the June 2009 futures contract) , and with volatility consistent at current market levels (i.e., we do not expect volatility to either increase or decrease). We believe this view is corroborated by market fundamentals and moreover by the forecast.org figures.**

Plot of VIX Index – Oct '08 – Feb '09

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Plot indicates relatively “stable” volatility in January and February of 2009

SPX – Recent Performance / Future Forecast

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S&P 500 Stock Index Forecast¹

Month	Date	Forecast Value	<u>50% Correct +/-</u>	<u>80% Correct +/-</u>
0	Jan-09	825.88	0	0
1	Feb-09	825	129.72	214.36
2	Mar-09	760	159.7	263.91
3	Apr-09	733	180.36	298.04
4	May-09	706	196.62	324.91
5	Jun-09	714	210.23	347.4
6	Jul-09	711	222.05	366.93
7	Aug-09	744	232.56	384.3
8	Sep-09	813	242.07	400.01

Updated Sunday, February 08, 2009
¹www.forecasts.org

As previously stated, our view is “down & stable”

Risk / Exposure Stance

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- Total exposure value: **\$200,000,000.**
- Our desired dollar loss limit for our exposure is 10% (**\$20,000,000**)
- Our desired loss probability is 5% (5/100)
- Thus, our critical probability level and the loss limit level yields the following statement:

We want only a 5% chance of losing \$20,000,000 (10% of exposure) or more

Scenario Detail – Underlying Exposure

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${}_0F_T = 861.0$ (SPM9 on Bloomberg)

$R = 1.28\%$; $RP = 5\%$

$T = 130/365 = .356$; Annualized $\sigma = 48.07\%$

Expected Future Spot Price = 865.76

$$(861.9 * (1 + (1.28\% + 5\%) * .356)) / (1 + (5\% * .356))$$

LOWER Critical Price = 546.18

$$(865.76 * e^{-(1.645 * 48.07\% * \text{sqrt } .356)})$$

HIGH Critical Price = 1408.77

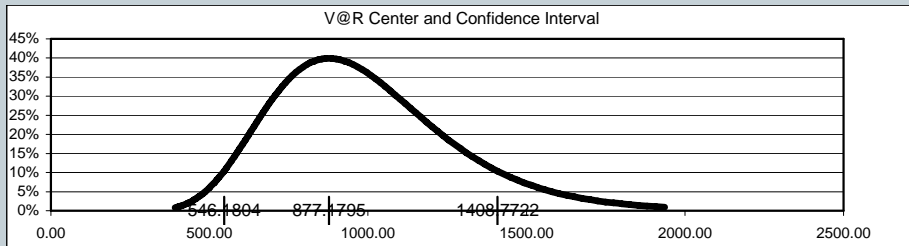
$$(865.76 * e^{+(1.645 * 48.07\% * \text{sqrt } .356)})$$

→ 27% of our long exposure may be retained (so must decrease position by ~ 73%)

→ We must sell 676 futures contracts to meet risk targets

Portfolio VaR

Price Value at Risk (V@R)		Underlying	SP	
Today: 2/9/2009	Futures price: 861.9	Monthly price volatility (stan. dev.): 13.877317		
Risk Limit: -20,000,000	# of contract underlying: 250	For Volatility - standard deviation information, http://riskmetrics.com/clients/data/cde/index.cgi		
# s.d. V@R (e.g. 1.00): 1.64	Exposure (+/-Contracts): 929	user is <u>guriskmetrics</u>		
Exposure (maturity) Date: 6/19/2009	\$ underlying: \$200,176,275	password is <u>riskmetrics</u>		
For risk premium-adjusted V@R	Adjustment (+/-Contracts): -676		OK@ 253	
Funding Rate: 1.28%	Monthly Estimates	T>30 days= 130		
Risk Premium Estimate: 5.00%	Riskmetrics (optional)	Riskmetrics inferred (optional)		
	weight last 150 obs. Own estimate	monthly vol*sqrt(130/30) Own estimate		
Standard deviations (s.d. E.g. 1% as 1.0)	13.8773	13.8773	28.8879	28.8879
Long V@R @ price*exp(-#*sd)	689.2804	689.2804	546.1804	546.1804
\$ V@R	-10,918,191	-10,918,191	-19,969,262	-19,969,262
Long upside @ price*exp(+*sd)	1086.6166	1086.6166	1408.7722	1408.7722
\$ profit	14,213,326	14,213,326	34,589,664	34,589,664



Probability of doing worse than -1.64 standard deviation (or 546.1804) is 5.05%

Target Loss	-9.99%	Simple	Log
Loss %	-36.63%		-45.62%
Keep	27.3%		21.9%
Hedge	-72.7%		-78.1%

	Probability	1 out of	with
for 1.00 s.d	15.87%	6	6.5% loss
for 1.28 s.d	10.03%	10	8.1% loss
for 1.44 s.d	7.49%	13	8.9% loss
for 1.65 s.d	4.95%	20	10.0% loss
for 2.00 s.d	2.28%	44	11.7% loss
for 2.33 s.d	1.00%	100	13.1% loss
for 3.09 s.d	0.100%	1000	15.9% loss
Check # s.d.	1.6		

27.2%

Team View – Direction & Volatility

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	Level of Confidence			
Vol vs. market	Unsure-Vol	=Market	Sure-Stable	Vol vs. market
Direction vs. market view	View = Vol up	View = Vol stable	View = Vol down	Direction vs. market view
Up-Unsure	forward & options cheap	forward cheap & options fair	forward cheap & options expensive	Up-Sure
No direction - ?	options cheap	forward & options fair	options expensive	No direction - Sure
Down-Unsure	forward expensive & options cheap	forward expensive & options fair	forward & options expensive	Down-Sure

Hedging Possibilities Explored

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Based on our market view (down) and volatility remaining at current levels we looked at the following strategies:

	Level of Confidence			
Vol vs. market	Unsure-Vol	=Market	Sure-Stable	Vol vs. market
Direction vs. market view	View = Vol up (options cheap)	View = Vol stable (option prices fair)	View = Vol down (options expensive)	Direction vs. market view
Up-Unsure (forward cheap)				Up-Sure (forward cheap)
No direction - ? (forward price fair)	+F+2P		+F-2C	No direction - Sure (forward price fair)
Down-Unsure (forward expensive)	-F+C	-F+C/2	-%F	Down-Sure (forward expensive)

Related ATM & OTM Options

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Closest to maturity futures price & maturity date
(June 2009 CME Calls & Puts):

ATM / OTM	Calls		Puts	
	Strike Price	Price Quote	Strike Price	Price Quote
ITM	700	\$ 108.20	700	\$ 42.80
ITM	750	\$ 76.40	750	\$ 60.80
ATM*	860	\$ 26.70	860	\$ 120.80
OTM	900	\$ 16.10	900	\$ 150.10
OTM	1000	\$ 3.25	1000	\$ 237.10

(http://data.tradingcharts.com/futures/.../spM9_2009-2-24; *ATM in reference to SPM9 = \$861.9)

Hedging Strategy

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- We are naturally “LONG” the S&P 500 ($+F_{SP}$)
- Due to our view that the S&P will go down in price until the June maturity date and that volatility will remain at current levels, we would ultimately like to be “SHORT” the S&P ($-F_{SP}$) in some of our positions
- There are several scenarios by which we could achieve this short position, and they are explored in the following slides.
- Note that in several of the following scenarios we take derivative positions greater than the number of futures contracts equivalent to our underlying exposure. Accordingly, we would report such “non-hedging” derivative positions as per FAS 133 / IAS 39.

Scenario #1 : $-F + C/2$

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L or S (Long/Short)	S	L
F, C, or P (Forward, Call, Put)	F	C
Forward/Strike Price	861.9	860.0
Price (C or P), 0.0 (F) - FV	0.00	75.74
Number of Contracts	258	129.0

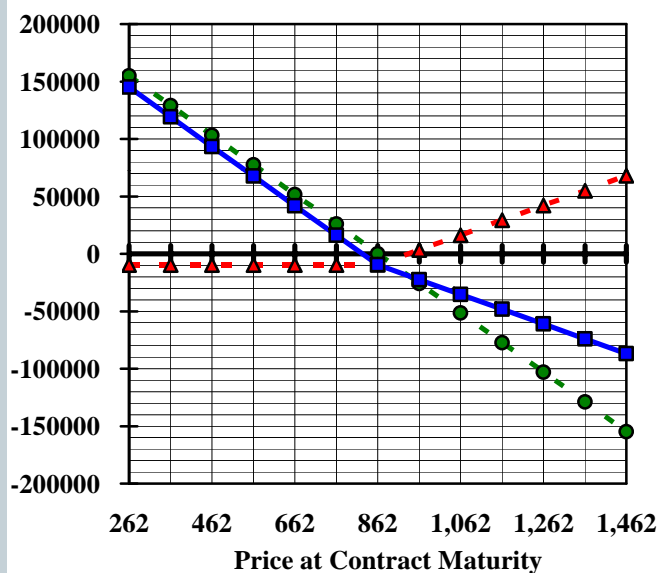
Calculated Profit of a

Combined $-258F+129C$ Position

Prices at Maturity		-258F	+129C	258F+129C	Profit
261.9	261.9	154800	-9771	145029	36,257,276
361.9	361.9	129000	-9771	119229	29,807,276
Step size	461.9	103200	-9771	93429	23,357,276
100.00	561.9	77400	-9771	67629	16,907,276
Input	661.9	51600	-9771	41829	10,457,276
Futures=>	761.9	25800	-9771	16029	4,007,276
Price	861.9	0	-9526	-9526	-2,381,449
	961.9	-25800	3374	-22426	-5,606,449
	1061.9	-51600	16274	-35326	-8,831,449
	1161.9	-77400	29174	-48226	-12,056,449
Strike F9	1261.9	-103200	42074	-61126	-15,281,449
to update	1361.9	-129000	54974	-74026	-18,506,449
	1461.9	-154800	67874	-86926	-21,731,449

@ Critical	547.20	81192	-9771	71421	17,855,367
Prices	1406.15	-140417	60683	-79734	-19,933,618
Max Loss		-154800	-9771	-86926	-21,731,449

Combined $-258F+129C$ Position



Down, Stable (Trade, Insure)

•Since we are +F 929 Contracts to begin with, by shorting 1187 Futures contracts, and buying 129 Calls, our overall position would yield: $-258F + 129C$

Scenario #2 : -%F

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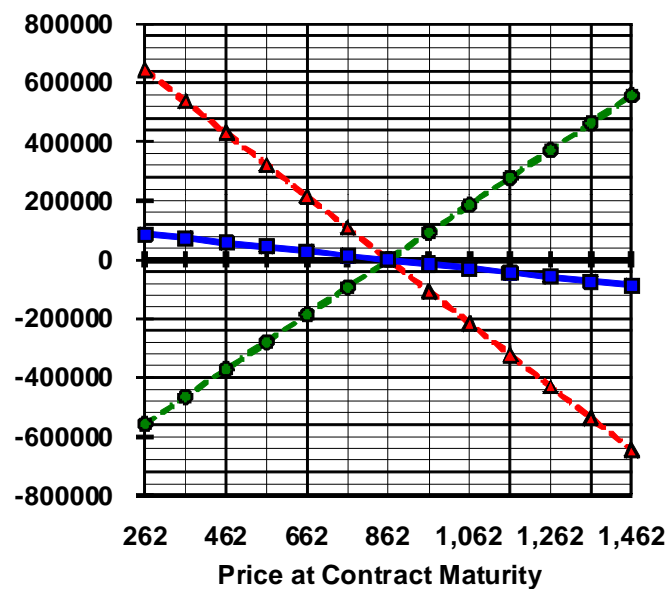
L or S (Long/Short)	L	S	
F, C, or P (Forward, Call, Put)	F	F	
Forward/Strike Price	861.9	861.9	
Price (C or P), 0.0 (F) - FV	0.00	0.00	Net
Number of Contracts	929	1075	-146

Calculated Profit of a
Combined +929F-1075F Position

Prices at	+929F	-1075F	+929F-1075F	Profit
Maturity 261.9	-557400	645000	87600	21,900,000
361.9	-464500	537500	73000	18,250,000
Step size 461.9	-371600	430000	58400	14,600,000
100.00 561.9	-278700	322500	43800	10,950,000
661.9	-185800	215000	29200	7,300,000
Input 761.9	-92900	107500	14600	3,650,000
Futures=> 861.9	0	0	0	0
Price 961.9	92900	-107500	-14600	-3,650,000
1061.9	185800	-215000	-29200	-7,300,000
1161.9	278700	-322500	-43800	-10,950,000
Strike F9 1261.9	371600	-430000	-58400	-14,600,000
to update 1361.9	464500	-537500	-73000	-18,250,000
1461.9	557400	-645000	-87600	-21,900,000

@ Critical	547.20	-292355	338302	45946	11,486,517
Prices	1406.15	505611	-585072	-79461	-19,865,246
Max Loss		-557400	-645000	-87600	-21,900,000

Combined +929F-1075F Position



Down, sure (Trade)

•Since we are +F 929 Contracts to begin with, by shorting 1075 Futures contracts, our overall position would yield: -146F

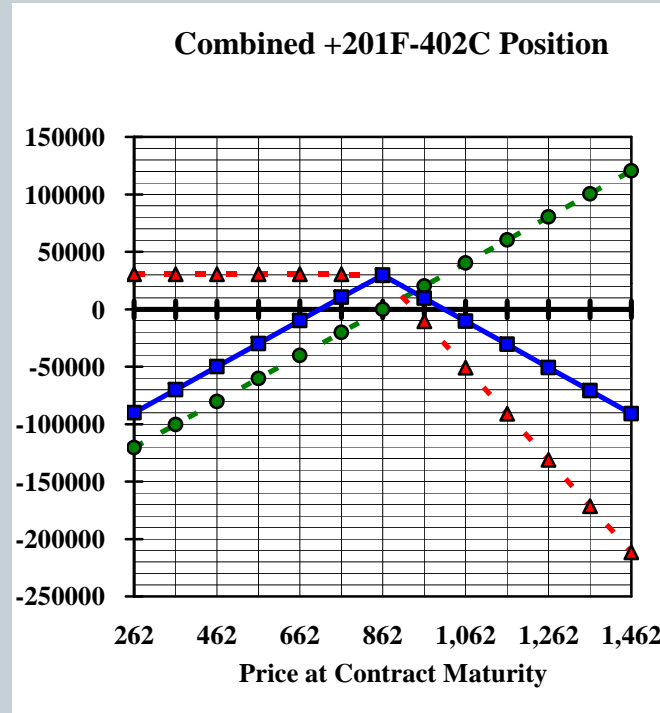
Scenario #3: +F -2C

L or S (Long/Short)	L	S
F, C, or P (Forward, Call, Put)	F	C
Forward/Strike Price	861.9	860.0
Price (C or P), 0.0 (F) - FV	0.00	75.74
Number of Contracts	201.00	402.00

Calculated Profit of a
Combined +201F-402C Position

Prices at Maturity	+201F	-402C	-201F-402C	Profit
261.9	-120600	30449	-90151	-22,537,789
361.9	-100500	30449	-70051	-17,512,789
461.9	-80400	30449	-49951	-12,487,789
561.9	-60300	30449	-29851	-7,462,789
661.9	-40200	30449	-9751	-2,437,789
761.9	-20100	30449	10349	2,587,211
861.9	0	29685	29685	7,421,261
961.9	20100	-10515	9585	2,396,261
1061.9	40200	-50715	-10515	-2,628,739
1161.9	60300	-90915	-30615	-7,653,739
1261.9	80400	-131115	-50715	-12,678,739
1361.9	100500	-171315	-70815	-17,703,739
1461.9	120600	-211515	-90915	-22,728,739

@ Critical Prices	547.20	-63255	30449	-32806	-8,201,419
	1406.15	109395	-189105	-79710	-19,927,468



No direction, sure (Trade, Income):
Synthetic Short Straddle

•Since we are +F 929 Contracts to begin with, by shorting 728 Futures contracts, and buying 402 Calls, our overall position would yield: +201F -402C

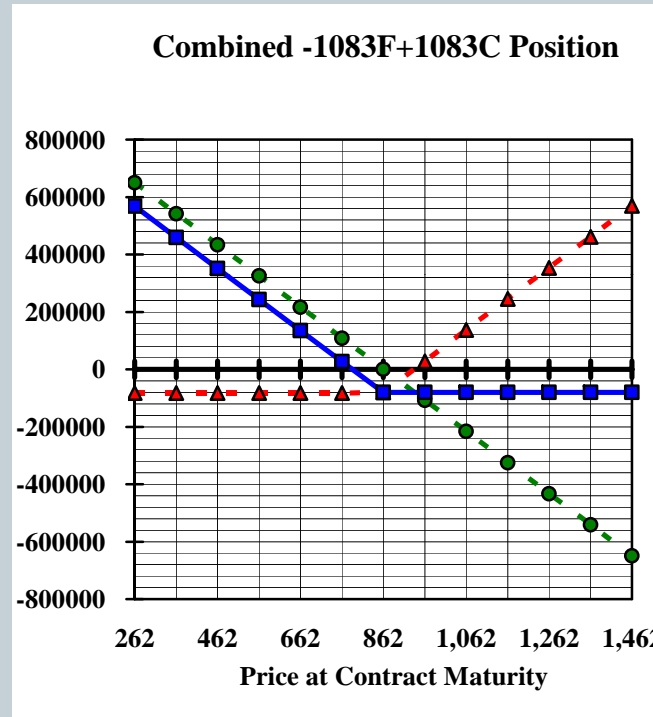
Scenario #4: -F +C

L or S (Long/Short)	S	L	
F, C, or P (Forward, Call, Put)	F	C	
Forward/Strike Price	861.9	860.0	
Price (C or P), 0.0 (F) - FV	0.00	75.74	Lower +929F
Number of Contracts	1083.0	1083	-2012

Calculated Profit of a
Combined -1083F+1083C Position

Prices at Maturity	-1083F	+1083C	083F+1083C	Profit
261.9	649800	-82030	567770	141,942,477
361.9	541500	-82030	459470	114,867,477
Step size	461.9	-82030	351170	87,792,477
100.00	561.9	-82030	242870	60,717,477
Input	661.9	-82030	134570	33,642,477
Futures=>	761.9	-82030	26270	6,567,477
Price	861.9	0	-79972	-19,993,098
	961.9	-108300	28328	-19,993,098
	1061.9	-216600	136628	-19,993,098
	1161.9	-324900	244928	-19,993,098
Strike F9	1261.9	-433200	353228	-19,993,098
to update	1361.9	-541500	461528	-19,993,098
	1461.9	-649800	569828	-19,993,098

@ Critical	547.20	340819	-82030	258789	64,697,257
Prices	1406.15	-589426	509454	-79972	-19,993,098
Max Loss		-649800	-82030	-79972	-19,993,098



Down, Vol (Trade, Insure):
Synthetic Long Put

•Since we are +F 929 Contracts to begin with, by shorting 2012 Futures contracts, and buying 1083 Calls, our overall position would yield: -1083F + 1083C

Scenario #5: +F +2P

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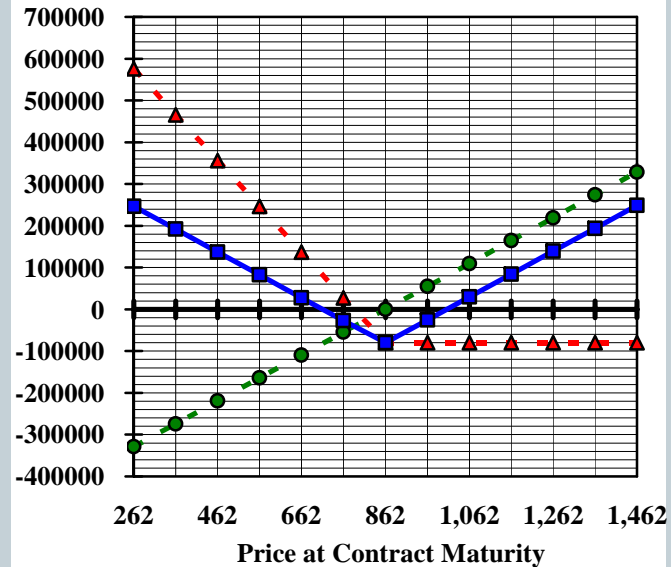
L or S (Long/Short)	L	L	
F, C, or P (Forward, Call, Put)	F	P	
Forward/Strike Price	861.9	860.0	
Price (C or P), 0.0 (F) - FV	0.00	72.98	Lower +929F
Number of Contracts	548	1096	381

Calculated Profit of a
Combined +548F+1096P Position

Prices at Maturity	+548F	+1096P	548F+1096P	Profit
261.9	-328800	575531	246731	61,682,643
361.9	-274000	465931	191931	47,982,643
Step size	461.9	356331	137131	34,282,643
100.00	561.9	-164400	82331	20,582,643
	661.9	-109600	27531	6,882,643
Input	761.9	-54800	-27269	-6,817,357
Futures=>	861.9	0	-79987	-19,996,757
Price	961.9	54800	-79987	-6,296,757
	1061.9	109600	-79987	7,403,243
	1161.9	164400	-79987	21,103,243
Strike F9	1261.9	219200	-79987	34,803,243
to update	1361.9	274000	-79987	48,503,243
	1461.9	328800	-79987	62,203,243

@ Critical	547.20	-172455	262841	90386	22,596,419
Prices	1406.15	298251	-79987	218264	54,565,945
Max Loss		-328800	-79987	-79987	-19,996,757

Combined +548F+1096P Position



No direction, Vol (Trade, Insure):
Synthetic Long Straddle

•Since we are +929F Contracts to begin with, by shorting 381 Futures contracts, and buying 1096 Puts our overall position would yield: +548F + 1096C

Recommendation & Conclusion

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- We believe that the S&P500 underlying will continue to fall and volatility will remain stable until our June exposure.
- Based on our exposure (+929F), market views and loss limits, our strategy is to sell 1187 Futures contracts, buy 129 Calls, for an overall position that would yield: -258F + 129C