

ACT 370, JAN 21/09

Note Title

IF $K_1 < K_2$, $C(K_1) \geq C(K_2)$, $P(K_1) \leq P(K_2)$

$$\boxed{C(K_1) - C(K_2) \leq K_2 - K_1} \quad P(K_2) - P(K_1) \leq K_2 - K_1$$

ASSUME $\underbrace{C(K_1) - C(K_2)} > \underbrace{K_2 - K_1}$ $\begin{matrix} 0 & & T \\ & \text{---} & \\ & & S_T \end{matrix}$

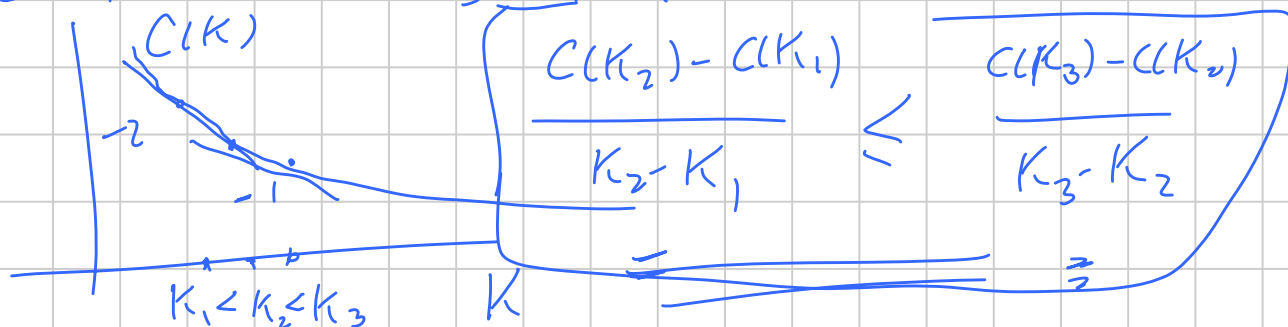
SELL CALL STRIKE K_1 , BUY CALL STRIKE K_2
 \hookrightarrow INVEST $C(K_1) - C(K_2)$ AT RISK FREE INT RATE

IF $S_T < K_1 < K_2 \rightarrow$ NEITHER OPTION IS EXERCISED
 \rightarrow PAYOFF, PROFIT > 0

IF $K_1 \leq S_T < K_2 \rightarrow$ K_1 STRIKE OPTION IS EXERCISED
 K_2 " " " " NOT " "
 GAIN $> -(S_T - K_1) + K_2 - K_1 = K_2 - S_T > 0$

IF $K_1 < K_2 \leq S_T \rightarrow$ BOTH OPTIONS ARE EXERCISED
 GAIN $> -(S_T - K_1) + (S_T - K_2) + K_2 - K_1 = 0$
 \hookrightarrow SINCE NO ARBITRAGE OPPORTUNITIES EXIST
 ASSUMPTION IS FALSE

CALL OPTION PRICE IS A CONVEX FUNCTION OF K (STRIKE)



$$\frac{C(K_1) - C(K_2)}{K_2 - K_1} \geq \frac{C(K_2) - C(K_3)}{K_3 - K_2}$$

$$\frac{(K_3 - K_2)(C(K_1) - C(K_2))}{K_3 - K_1} \geq \frac{(K_2 - K_1)(C(K_2) - C(K_3))}{K_3 - K_1}$$

$$\rightarrow \left(\frac{K_3 - K_2}{K_3 - K_1} \right) C(K_1) + \left(\frac{K_2 - K_1}{K_3 - K_1} \right) C(K_3) \geq C(K_2) \leftarrow \text{TRUE}$$

$$\lambda = \frac{K_3 - K_2}{K_3 - K_1} \quad 1 - \lambda = \frac{K_2 - K_1}{K_3 - K_1} \rightarrow K_2 = \lambda K_1 + (1 - \lambda) K_3$$

$$\text{ASSUME } \left(\frac{K_3 - K_2}{K_3 - K_1} \right) C(K_1) + \left(\frac{K_2 - K_1}{K_3 - K_1} \right) C(K_3) < C(K_2)$$

$$K_1 < K_2 < K_3 \quad \lambda C(K_1) + (1 - \lambda) C(K_3) < C(K_2)$$

SELL CALL STRIKE K_2

BUY λ UNITS CALL STRIKE K_1

BUY $1 - \lambda$ UNITS CALL STRIKE K_3

INVEST $C(K_2) - [\lambda C(K_1) + (1 - \lambda) C(K_3)]$ AT RISK-FREE RATE

IF $S_T < K_1 \rightarrow$ NO OPTION IS EXERCISED \rightarrow GAIN > 0

IF $K_1 \leq S_T < K_2 \rightarrow$ EXERCISE $K_1 \rightarrow$ GAIN $\lambda (S_T - K_1) > 0$

IF $K_2 \leq S_T < K_3 \rightarrow$ EXERCISE K_1, K_2

$$\text{GAIN} > \lambda (S_T - K_1) - (S_T - K_2)$$

$$= K_2 - \lambda K_1 - (1 - \lambda) S_T = (1 - \lambda) K_3 - (1 - \lambda) S_T$$

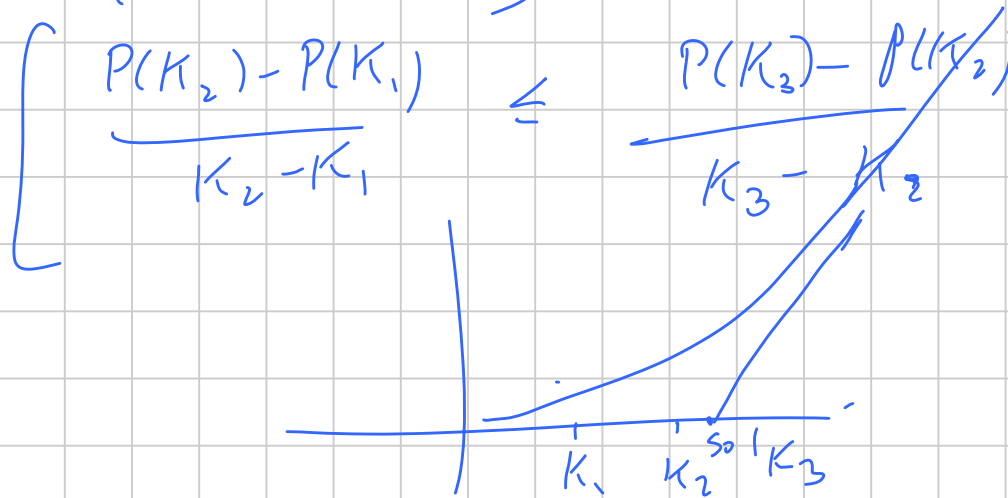
$$= (1-\lambda)(K_3 - S_T) > 0$$

IF $S_T > K_3 \rightarrow$ ALL OPTIONS ARE EXERCISED

$$\text{GAIN} > \lambda(S_T - K_1) - (S_T - K_2) + (1-\lambda)(S_T - K_3) = 0$$

CONVEXITY FOR PUT PRICES

$$K_1 < K_2 < K_3$$



UTILITY THEORY

$W \equiv$ WEALTH LEVEL

UTILITY FUNCTION $U(W)$, NON-DECREASING

X IS RANDOM VARIABLE, $E(X)$ MEAN OF X

$$E[U(X)] = U(G) \leftarrow \text{EXPECTED UTILITY PRINCIPLE}$$

$$X \sim \text{UNIF}[0, 100] \quad E(X) = 50$$

$$(ii) \quad U(W) = W^2 \rightarrow G^2 = E[X^2] = \frac{10,000}{3} \rightarrow G = \underline{\underline{57.7}}$$

RISK-TAKER



JENSEN'S INEQUALITY: RANDOM VAR &

$$E[g(X)] \geq g[E(X)]$$

$$E[X^2] \geq [E(X)]^2$$

FUNCTION $g(x)$, $g'' > 0$
 $g(x) = x^2$

$$\text{VAR}(X) = E(X^2) - (E(X))^2 \geq 0$$

$$= E[(X - E(X))^2]$$

RISK-TAKER

$$u(w), u' \geq 0, u'' \geq 0$$

$$a \leq b \Leftrightarrow u(a) \leq u(b)$$

$$u(G) = E[u(X)] \geq u[E(X)]$$

$$G \geq E(X)$$

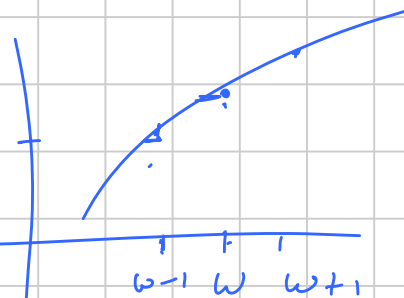
RISK-AVERSE

(ii) $u'' \leq 0, u' > 0$

$$u(w) = \sqrt{w}$$

$X \sim \text{UNIF}[0, 100]$

$$E(X) = 50$$



$$u(G) = E[u(X)]$$

$$\sqrt{G} = E[\sqrt{X}]$$

$$\int_0^{100} \frac{1}{100} \sqrt{x} dx = \frac{20}{3}$$

$$G = 44.4$$

RISK-NEUTRAL

(iii) $u'' = 0 \rightarrow u(w) = \text{LINEAR} \equiv a w + b$

$$u(G) = E[u(X)]$$

$$aG + b = E[aX + b] \rightarrow G = E(X)$$



$$w = 100$$

LOSS $X \sim \text{UNIF}[0, 100]$

$$E(X) = 50$$

$$u(w) = \sqrt{w}$$

$$100 - X$$

$$u'' < 0$$

$$u(100 - P) = E[u(100 - X)]$$

$$\sqrt{100 - P} = E\left[\sqrt{100 - X}\right] \rightarrow P = \underline{\underline{55.6}}$$

$$\int_0^{100} (100 - x)^{1/2} \cdot \frac{1}{100} dx$$

BINOMIAL MODEL FOR ASSET PRICES

0 1

S_0 SECURITY $S_1 = \begin{cases} S_0 \cdot u \\ S_0 \cdot d \end{cases}$ $d < u$

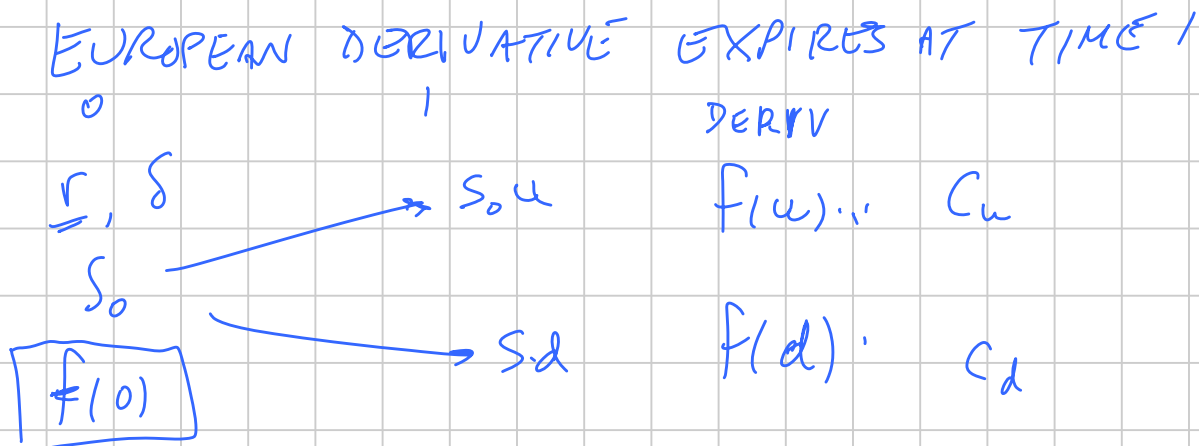
CONTIN. COMP RISK FREE INT RATE r
 CONTIN DIV RATE δ (PER UNIT TIME)

$d \leq e^{r-\delta} \leq u$ IN ORDER THAT NO ARBITRAGE OPPORTUNITIES EXIST

ASSUME $e^{r-\delta} > u \rightarrow$ SELL (SHORT) e^{δ} UNITS OF SEC.
 INVEST AT RISK FREE RATE

AT $t=1$ $S_0 e^{r-\delta} > S_0 \cdot u > S_0 \cdot d$

DERIVATIVE SECURITY BASED ON UNDERLYING ASSET
 VALUE OF DERIVATIVE IS A FUNCTION OF VALUE OF UNDERLYING SECURITY



AMD

16.00 -1.51

Jan 24, 2007 @ 16:10 ET (Data 20 Minutes Delayed)

Bid N/A Ask N/A Size N/AxN/A Vol 66422200

Calls	Last Sale	Net	Bid	Ask	Vol	Open Int	Puts	Last Sale	Net	Bid	Ask	Vol	Open Int
07 Jul 30.00 (AMD GF-E)	0.10	-0.10	0.05	0.15	30	1759	07 Jul 30.00 (AMD SF-E)	12.30	pc	13.90	14.10	0	20
07 Jul 35.00 (AKD GG-E)	0.20	pc	0	0.10	0	1176	07 Jul 35.00 (AKD SG-E)	13.82	pc	18.90	19.10	0	0
07 Jul 40.00 (AKD GH-E)	0.05	pc	0	0.05	0	438	07 Jul 40.00 (AKD SH-E)	0	pc	23.90	24.10	0	0
07 Jul 45.00 (AKD GI-E)	0.05	pc	0	0.05	0	487	07 Jul 45.00 (AKD SI-E)	0	pc	28.90	29.10	0	0
07 Jul 50.00 (AKD GJ-E)	0.05	pc	0	0.05	0	176	07 Jul 50.00 (AKD SJ-E)	0	pc	33.90	34.10	0	0
08 Jan 5.00 (WVV AA-E)	13.30	pc	11.20	11.40	0	2479	08 Jan 5.00 (WVV MA-E)	0.10	-0.02	0.05	0.15	879	43012
08 Jan 7.50 (WVV AR-E)	10.80	pc	9.00	9.10	0	1769	08 Jan 7.50 (WVV MR-E)	0.20	--	0.15	0.20	25	8873
08 Jan 10.00 (WVV AB-E)	6.88	-2.22	6.90	7.00	42	2512	08 Jan 10.00 (WVV MB-E)	0.35	--	0.35	0.40	35	14553
08 Jan 12.50 (WVV AV-E)	4.93	-1.27	4.90	5.10	1202	1475	08 Jan 12.50 (WVV MV-E)	0.85	+0.15	0.80	0.85	830	7221
08 Jan 15.00 (WVV AC-E)	3.40	-1.20	3.30	3.50	1961	6782	08 Jan 15.00 (WVV MC-E)	1.75	+0.40	1.70	1.80	484	19665
08 Jan 17.50 (WVV AW-E)	2.30	-1.10	2.30	2.35	974	7857	08 Jan 17.50 (WVV MW-E)	3.00	+0.55	3.00	3.10	138	22811
08 Jan 20.00 (WVV AD-E)	1.55	-0.65	1.50	1.55	824	13469	08 Jan 20.00 (WVV MD-E)	4.70	+0.83	4.70	4.80	191	21303
08 Jan 22.50 (WVV AX-E)	1.05	-0.50	1.00	1.05	909	13557	08 Jan 22.50 (WVV MX-E)	6.80	+1.10	6.70	6.90	64	10253
08 Jan 25.00 (WVV AE-E)	0.70	-0.40	0.65	0.70	147	12199	08 Jan 25.00 (WVV ME-E)	9.00	+1.20	9.00	9.10	45	14955
08 Jan 27.50 (WVV AY-E)	0.50	-0.30	0.45	0.50	9	11507	08 Jan 27.50 (WVV MY-E)	11.30	+1.20	11.40	11.60	2	1622
08 Jan 30.00 (WVV AF-E)	0.35	-0.15	0.30	0.40	73	19514	08 Jan 30.00 (WVV MF-E)	13.80	+1.43	13.90	14.10	20	5562
08 Jan 35.00 (WVV AG-E)	0.15	-0.15	0.15	0.20	3	11420	08 Jan 35.00 (WVV MG-E)	17.60	pc	18.90	19.10	0	1343
08 Jan 40.00 (WVV AH-E)	0.15	-0.10	0.10	0.15	60	7080	08 Jan 40.00 (WVV MH-E)	18.20	pc	23.90	24.10	0	528
08 Jan 45.00 (WVV AI-E)	0.15	pc	0.05	0.10	0	3105	08 Jan 45.00 (WVV MI-E)	17.90	pc	28.90	29.10	0	0
08 Jan 50.00 (WVV AJ-E)	0.05	-0.10	0	0.10	40	5246	08 Jan 50.00 (WVV MJ-E)	24.20	pc	33.90	34.10	0	40
08 Jan 60.00 (WVV AL-E)	0.10	pc	0	0.05	0	8999	08 Jan 60.00 (WVV ML-E)	29.60	pc	43.90	44.10	0	0
08 Jan 70.00 (WVV AN-E)	0.05	pc	0	0.05	0	1553	08 Jan 70.00 (WVV MN-E)	35.00	pc	53.80	54.10	0	0
08 Jan 80.00 (LDY AP-E)	0.25	pc	0	0.05	0	1276	08 Jan 80.00 (LDY MP-E)	50.40	pc	63.80	64.10	0	0
08 Jan 80.00 (WVV AP-E)	0	pc	0	0	0	0	08 Jan 80.00 (WVV MP-E)	0	pc	0	0	0	0
08 Jan 90.00 (LDY AR-E)	0.05	pc	0	0.05	0	2303	08 Jan 90.00 (LDY MR-E)	65.30	pc	73.80	74.10	0	0
08 Jan 90.00 (WVV AS-E)	0	pc	0	0	0	0	08 Jan 90.00 (WVV MS-E)	0	pc	0	0	0	0
08 Jan 100.0 (LDY AT-E)	0.10	pc	0	0.05	0	2209	08 Jan 100.0 (LDY MT-E)	79.80	pc	83.80	84.10	0	17
08 Jan 100.0 (WVV AT-E)	0	pc	0	0	0	0	08 Jan 100.0 (WVV MT-E)	0	pc	0	0	0	0
09 Jan 5.00 (VVV AA-E)	13.50	pc	11.60	11.80	0	1789	09 Jan 5.00 (VVV MA-E)	0.20	--	0.15	0.25	391	8794
09 Jan 10.00 (VVV AB-E)	8.10	-1.00	7.60	7.80	5	593	09 Jan 10.00 (VVV MB-E)	0.80	+0.10	0.70	0.80	193	6333
09 Jan 12.50 (VVV AV-E)	7.50	pc	6.00	6.20	0	889	09 Jan 12.50 (VVV MV-E)	1.40	+0.10	1.35	1.50	95	6746
09 Jan 15.00 (VVV AC-E)	4.90	-1.80	4.70	4.90	225	2325	09 Jan 15.00 (VVV MC-E)	2.40	+0.15	2.35	2.45	205	11783
09 Jan 17.50 (VVV AW-E)	3.90	-1.10	3.80	3.90	54	1166	09 Jan 17.50 (VVV MW-E)	3.70	+0.40	3.70	3.90	60	2320
09 Jan 20.00 (VVV AD-E)	3.10	-0.80	2.90	3.10	309	2771	09 Jan 20.00 (VVV MD-E)	5.27	+0.37	5.30	5.50	53	1914
09 Jan 25.00 (VVV AE-E)	1.85	-0.80	1.80	1.90	218	3378	09 Jan 25.00 (VVV ME-E)	9.26	+1.06	9.30	9.40	70	2050



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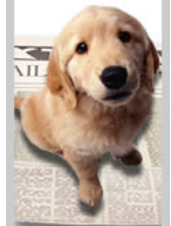


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6.75 -0.0801

Jan 23, 2008 @ 10:10 ET

Bid N/E Ask N/E Size N/E X N/E Vol 1711617

Calls	Last Sale	Net	Bid	Ask	Vol	Open Int	Puts	Last Sale	Net	Bid	Ask	Vol	Open Int
08 Feb 4.00 (AMD BV-E)	2.54	0.0	2.77	2.89	0	2011	08 Feb 4.00 (AMD NV-E)	0.04	0.0	0.02	0.08	0	2896
08 Feb 5.00 (AMD BA-E)	2.08	0.0	1.87	1.98	0	3575	08 Feb 5.00 (AMD NA-E)	0.09	+0.02	0.09	0.13	12	5539
08 Feb 6.00 (AMD BI-E)	1.00	-0.16	1.07	1.15	110	8279	08 Feb 6.00 (AMD NI-E)	0.27	+0.02	0.26	0.29	115	5555
08 Feb 7.00 (AMD BJ-E)	0.49	-0.03	0.48	0.52	18	15818	08 Feb 7.00 (AMD NJ-E)	0.67	+0.01	0.66	0.70	97	11858
08 Feb 8.00 (AMD BK-E)	0.20	0.0	0.17	0.20	60	15547	08 Feb 8.00 (AMD NK-E)	1.28	0.0	1.32	1.42	0	3453
08 Feb 9.00 (AMD BL-E)	0.08	0.0	0.06	0.10	0	6510	08 Feb 9.00 (AMD NL-E)	2.09	0.0	2.18	2.30	0	1072
08 Feb 10.00 (AMD BB-E)	0.03	0.0	0.02	0.04	0	3498	08 Feb 10.00 (AMD NB-E)	3.20	0.0	3.10	3.30	0	545
08 Feb 11.00 (AMD BM-E)	0.04	0.0	0.01	0.05	0	328	08 Feb 11.00 (AMD NM-E)	4.75	0.0	4.10	4.25	0	72
08 Mar 3.00 (AMD CG-E)	0.0	0.0	3.80	4.00	0	0	08 Mar 3.00 (AMD OG-E)	0.0	0.0	0.04	0.08	0	0
08 Mar 4.00 (AMD CV-E)	0.0	0.0	2.89	3.05	0	0	08 Mar 4.00 (AMD OV-E)	0.0	0.0	0.10	0.15	0	0
08 Mar 5.00 (AMD CA-E)	0.0	0.0	2.05	2.15	0	0	08 Mar 5.00 (AMD OE-E)	0.0	0.0	0.24	0.28	0	10
08 Mar 6.00 (AMD CI-E)	1.29	-0.11	1.34	1.40	10	160	08 Mar 6.00 (AMD OF-E)	0.49	0.0	0.51	0.54	0	357
08 Mar 7.00 (AMD CJ-E)	0.79	-0.07	0.81	0.84	6	235	08 Mar 7.00 (AMD OJ-E)	0.99	0.0	0.95	0.98	0	222
08 Mar 8.00 (AMD CK-E)	0.41	-0.05	0.43	0.47	10	122	08 Mar 8.00 (AMD OK-E)	1.56	0.0	1.56	1.62	0	79
08 Mar 9.00 (AMD CL-E)	0.26	0.0	0.24	0.26	0	221	08 Mar 9.00 (AMD OL-E)	0.0	0.0	2.36	2.45	0	0
08 Mar 10.00 (AMD CB-E)	0.15	0.0	0.12	0.16	0	49	08 Mar 10.00 (AMD OB-E)	0.0	0.0	3.20	3.35	0	0
08 Mar 11.00 (AMD CM-E)	0.0	0.0	0.05	0.09	0	10	08 Mar 11.00 (AMD OM-E)	0.0	0.0	4.15	4.30	0	11
08 Apr 4.00 (AMD DV-E)	2.82	0.0	2.99	3.15	0	44	08 Apr 4.00 (AMD PV-E)	0.19	0.0	0.18	0.24	0	1625
08 Apr 5.00 (AMD DA-E)	2.30	0.0	2.22	2.31	0	1325	08 Apr 5.00 (AMD PA-E)	0.40	0.0	0.39	0.43	0	24204
08 Apr 6.00 (AMD DI-E)	1.60	0.0	1.54	1.63	0	13556	08 Apr 6.00 (AMD PI-E)	0.73	0.0	0.70	0.75	0	5494
08 Apr 7.00 (AMD DJ-E)	1.08	0.0	1.03	1.11	0	7001	08 Apr 7.00 (AMD PJ-E)	1.15	0.0	1.16	1.22	0	5404
08 Apr 8.00 (AMD DK-E)	0.73	0.0	0.66	0.72	0	7921	08 Apr 8.00 (AMD PK-E)	1.72	0.0	1.77	1.83	0	4961

08 Apr 9.00 (AMD DL-E)	0.44	+0.01	0.40	0.45	15	15880	08 Apr 9.00 (AMD PL-E)	2.60	0.0	2.51	2.61	0	3768
08 Apr 10.00 (AMD DB-E)	0.28	0.0	0.23	0.30	0	10870	08 Apr 10.00 (AMD PB-E)	3.55	+0.20	3.30	3.45	5	21283
08 Apr 11.00 (AMD DM-E)	0.19	0.0	0.16	0.21	0	5210	08 Apr 11.00 (AMD PM-E)	4.05	0.0	4.25	4.40	0	5391
08 Apr 12.00 (AMD DN-E)	0.12	0.0	0.10	0.15	0	6849	08 Apr 12.00 (AMD PN-E)	5.65	0.0	5.15	5.30	0	16456
08 Apr 13.00 (AMD DO-E)	0.09	0.0	0.07	0.13	0	9216	08 Apr 13.00 (AMD PO-E)	6.35	0.0	6.15	6.30	0	2916
08 Apr 14.00 (AMD DP-E)	0.10	0.0	0.04	0.10	0	28984	08 Apr 14.00 (AMD PP-E)	7.85	0.0	7.15	7.35	0	4542
08 Apr 15.00 (AMD DC-E)	0.07	0.0	0.03	0.09	0	11515	08 Apr 15.00 (AMD PC-E)	7.25	0.0	8.10	8.30	0	534
08 Apr 16.00 (AMD DQ-E)	0.06	0.0	0.02	0.06	0	6317	08 Apr 16.00 (AMD PQ-E)	7.05	0.0	9.10	9.25	0	169
08 Apr 20.00 (AMD DD-E)	0.03	0.0	0.0	0.04	0	3795	08 Apr 20.00 (AMD PD-E)	12.02	0.0	13.10	13.40	0	5
08 Apr 22.50 (AMD DU-E)	0.02	0.0	0.0	0.04	0	1425	08 Apr 22.50 (AMD PU-E)	8.75	0.0	15.60	15.90	0	0
08 Jul 4.00 (AMD GV-E)	3.50	0.0	3.20	3.40	0	287	08 Jul 4.00 (AMD SV-E)	0.45	0.0	0.42	0.50	0	847
08 Jul 5.00 (AMD GA-E)	2.79	0.0	2.56	2.68	0	5411	08 Jul 5.00 (AMD SA-E)	0.71	0.0	0.71	0.78	0	7256
08 Jul 6.00 (AMD GI-E)	2.20	0.0	1.98	2.11	0	1782	08 Jul 6.00 (AMD SI-E)	1.08	0.0	1.11	1.16	0	2040
08 Jul 7.00 (AMD GJ-E)	1.52	-0.01	1.50	1.61	10	10419	08 Jul 7.00 (AMD SJ-E)	1.60	0.0	1.59	1.68	0	6805
08 Jul 8.00 (AMD GK-E)	1.19	0.0	1.13	1.20	0	12528	08 Jul 8.00 (AMD SK-E)	2.16	0.0	2.19	2.27	0	3369
08 Jul 9.00 (AMD GL-E)	0.83	0.0	0.81	0.89	0	3361	08 Jul 9.00 (AMD SL-E)	2.72	0.0	2.88	3.00	0	7352
08 Jul 10.00 (AMD GB-E)	0.66	0.0	0.62	0.71	0	7392	08 Jul 10.00 (AMD SB-E)	3.55	0.0	3.65	3.80	0	1488
08 Jul 11.00 (AMD GM-E)	0.46	0.0	0.44	0.51	0	8018	08 Jul 11.00 (AMD SM-E)	4.50	0.0	4.50	4.65	0	1522
08 Jul 12.00 (AMD GN-E)	0.35	0.0	0.32	0.42	0	2839	08 Jul 12.00 (AMD SN-E)	4.85	0.0	5.40	5.55	0	4669
08 Jul 13.00 (AMD GO-E)	0.28	0.0	0.25	0.30	0	2153	08 Jul 13.00 (AMD SO-E)	6.05	0.0	6.30	6.50	0	553
08 Jul 14.00 (AMD GP-E)	0.16	0.0	0.19	0.23	0	1006	08 Jul 14.00 (AMD SP-E)	7.65	0.0	7.20	7.35	0	1020
08 Jul 15.00 (AMD GC-E)	0.15	0.0	0.13	0.18	0	1328	08 Jul 15.00 (AMD SC-E)	8.65	0.0	8.15	8.35	0	4222
08 Jul 16.00 (AMD GQ-E)	0.26	0.0	0.10	0.14	0	383	08 Jul 16.00 (AMD SQ-E)	7.15	0.0	9.15	9.35	0	52
08 Jul 17.00 (AMD GH-E)	0.09	0.0	0.06	0.12	0	555	08 Jul 17.00 (AMD SH-E)	9.80	0.0	10.10	10.35	0	104
09 Jan 2.50 (VVV AZ-E)	4.90	0.0	4.65	4.90	0	193	09 Jan 2.50 (VVV MZ-E)	0.38	0.0	0.37	0.45	0	3387
09 Jan 5.00 (VVV AA-E)	3.35	0.0	3.05	3.25	0	3644	09 Jan 5.00 (VVV MA-E)	1.21	0.0	1.22	1.32	0	50957
09 Jan 7.50 (VVV AR-E)	2.04	0.0	2.02	2.13	0	3771	09 Jan 7.50 (VVV MR-E)	2.61	0.0	2.55	2.65	0	16271
09 Jan 10.00 (VVV AB-E)	1.33	0.0	1.26	1.42	0	8514	09 Jan 10.00 (VVV MB-E)	4.30	0.0	4.25	4.45	0	113832
09 Jan 12.50 (VVV AV-E)	0.90	0.0	0.78	0.87	0	26895	09 Jan 12.50 (VVV MV-E)	6.20	0.0	6.25	6.40	0	57285
09 Jan 15.00 (VVV AC-E)	0.50	-0.10	0.49	0.58	9	26518	09 Jan 15.00 (VVV MC-E)	8.50	0.0	8.40	8.60	0	33341
09 Jan 17.50 (VVV AW-E)	0.34	0.0	0.29	0.37	0	15300	09 Jan 17.50 (VVV MW-E)	12.25	0.0	10.75	10.90	0	9775
09 Jan 20.00 (VVV AD-E)	0.24	0.0	0.18	0.24	0	42689	09 Jan 20.00 (VVV MD-E)	12.73	0.0	13.15	13.35	0	2164
09 Jan 25.00 (VVV AE-E)	0.15	0.0	0.08	0.14	0	44831	09 Jan 25.00 (VVV ME-E)	11.50	0.0	18.10	18.35	0	0
09 Jan 30.00 (VVV AF-E)	0.12	0.0	0.0	0.09	0	9554	09 Jan 30.00 (VVV MF-E)	17.15	0.0	23.10	23.40	0	5
09 Jan 35.00 (VVV AG-E)	0.12	+0.11	0.01	0.10	12	5945	09 Jan 35.00 (VVV MG-E)	26.05	0.0	28.10	28.40	0	0
09 Jan 40.00 (VVV AH-E)	0.01	0.0	0.01	0.05	0	8759	09 Jan 40.00 (VVV MH-E)	18.98	0.0	33.05	33.35	0	0
09 Jan 45.00 (VVV AI-E)	0.10	0.0	0.0	0.07	0	1033	09 Jan 45.00 (VVV MI-E)	23.85	0.0	38.00	38.50	0	0
09 Jan 50.00 (VVV AJ-E)	0.09	0.0	0.0	0.06	0	3770	09 Jan 50.00 (VVV MJ-E)	28.30	0.0	43.10	43.35	0	10
09 Jan 55.00 (VVV AK-E)	0.04	0.0	0.0	0.06	0	579	09 Jan 55.00 (VVV MK-E)	27.90	0.0	48.05	48.40	0	0
09 Jan 60.00 (VVV AL-E)	0.05	0.0	0.0	0.06	0	554	09 Jan 60.00 (VVV ML-E)	0.0	0.0	53.10	53.35	0	0
09 Jan 65.00 (VVV AM-E)	0.07	0.0	0.0	0.07	0	375	09 Jan 65.00 (VVV MM-E)	0.0	0.0	58.05	58.50	0	0
09 Jan 70.00 (VVV AN-E)	0.04	0.0	0.0	0.04	0	3740	09 Jan 70.00 (VVV MN-E)	55.30	0.0	63.10	63.35	0	0
10 Jan 2.50 (WVV AZ-E)	5.45	0.0	4.85	5.30	0	516	10 Jan 2.50 (WVV MZ-E)	0.67	0.0	0.60	0.78	0	2553
10 Jan 5.00 (WVV AA-E)	3.75	0.0	3.70	4.00	0	1085	10 Jan 5.00 (WVV MA-E)	1.75	0.0	1.74	1.93	0	50738
10 Jan 7.50 (WVV AR-E)	3.05	0.0	2.74	3.05	0	6168	10 Jan 7.50 (WVV MR-E)	3.40	+0.40	3.15	3.50	126	23102
10 Jan 10.00 (WVV AB-E)	2.00	0.0	1.98	2.19	0	23002	10 Jan 10.00 (WVV MB-E)	5.00	0.0	4.80	5.05	0	28322
10 Jan 12.50 (WVV AS-E)	1.23	0.0	1.41	1.67	0	6504	10 Jan 12.50 (WVV MS-E)	6.50	0.0	6.70	7.00	0	9111
10 Jan 15.00 (WVV AC-E)	1.01	-0.02	1.02	1.26	146	12550	10 Jan 15.00 (WVV MC-E)	9.15	0.0	8.85	9.10	0	11301
10 Jan 17.50 (WVV AW-E)	0.77	0.0	0.76	0.98	0	13269	10 Jan 17.50 (WVV MW-E)	10.60	0.0	10.95	11.30	0	3167
10 Jan 20.00 (WVV AD-E)	0.43	0.0	0.49	0.74	0	5639	10 Jan 20.00 (WVV MD-E)	12.83	0.0	13.25	13.60	0	276
10 Jan 22.50 (WVV AU-E)	0.47	0.0	0.39	0.59	0	497	10 Jan 22.50 (WVV MU-E)	0.0	0.0	15.60	15.95	0	20
10 Jan 25.00 (WVV AE-E)	0.35	0.0	0.30	0.51	0	13483	10 Jan 25.00 (WVV ME-E)	13.10	0.0	17.95	18.60	0	0



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