

Black Scholes Analysis

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In this analysis, we calculate the prices of the European call options and European put options of the equities in our investment portfolio.

In the calculations, we calculate the returns and volatilities using the assets' prices for 1 calendar year. The risk-free rate is from <https://www.marketwatch.com/investing/bond/tmubmusd01y?countrycode=bx>. We assume that there are 251 trade days in a calendar year, this is used to annualize the returns and standard deviations of the assets. We will set the strike price equal to 80% of the current price for the option calculations. We will calculate the prices of option with expiration period 1 calendar year.

Our investment portfolio includes the following assets, with purchasing prices (close prices) from 9/16/2022. In this analysis, **we do not include the U.S. 30 Year Treasury bonds in our calculation.**

Ticker	Type	Sector	Units	Amount
US30Y	U.S. 30 Year Treasury	NaN	467317.00	42262981.19
HSN	Common Stock	COMMERCIAL SERVICES	36138.24	1263031.49
GOGO	Common Stock	COMMUNICATIONS	94822.19	1263031.57
JAKK	Common Stock	CONSUMER DURABLES	54044.99	1263031.42
CALM	Common Stock	CONSUMER NON-DURABLES	22216.91	1263031.33
HRB	Common Stock	CONSUMER SERVICES	28111.09	1263031.27
HDSN	Common Stock	DISTRIBUTION SERVICES	159071.98	1263031.52
BELFA	Common Stock	ELECTRONIC TECHNOLOGY	44285.81	1263031.30
ARLP	Common Stock	ENERGY MINERALS	52890.76	1263031.35
CI	Common Stock	HEALTH SERVICES	4350.03	1263031.21
SRTS	Common Stock	HEALTH TECHNOLOGY	85339.97	1263031.56
LNG	Common Stock	INDUSTRIAL SERVICES	7551.75	1263030.19
BSM	Common Stock	MISCELLANEOUS	80447.87	1263031.56
HUDI	Common Stock	NON-ENERGY MINERALS	42612.40	1263031.54
CF	Common Stock	PROCESS INDUSTRIES	12810.95	1263031.56
CSL	Common Stock	PRODUCER MANUFACTURING	4335.84	1263030.19
MUSA	Common Stock	RETAIL TRADE	4561.65	1263029.65
AZPN	Common Stock	TECHNOLOGY SERVICES	5579.50	1263031.42

Ticker	Type	Sector	Units	Amount
ASC	Common Stock	TRANSPORTATION	126303.15	1263031.50
ED	Common Stock	UTILITIES	12966.13	1263030.72
YCS	ETF	NaN	25261.96	1599839.93
UUP	ETF	NaN	54416.32	1599839.81
EUO	ETF	NaN	47870.73	1599839.80
EWV	ETF	NaN	79832.33	1599839.89
DIG	ETF	NaN	44390.67	1599839.75
TTT	ETF	NaN	23645.28	1599839.64
ERX	ETF	NaN	29349.47	1599839.61
TMV	ETF	NaN	13430.49	1599839.97
TBT	ETF	NaN	54509.02	1599839.74
TYO	ETF	NaN	127782.74	1599839.90

In our calculations, we used annualized standard deviation of the daily log returns as the volatility and the log return of the risk-free rate. Additionally, we calculate the ratio of option price to the current asset price. The following is the result of our calculations.

	Stock price	Strike price	Risk free rate	Time period	volatility	Call price	Put price	Strike to price	Call to price	Put to price
ARLP	22.76	18.208	0.044945	1	0.479219	7.044185	1.691950	0.8	0.309498	0.074339
ASC	11.69	9.352	0.044945	1	0.591874	4.008553	1.259536	0.8	0.342904	0.107745
AZPN	253.64	202.912	0.044945	1	0.363252	70.333709	10.687801	0.8	0.277297	0.042138
BELFA	30.21	24.168	0.044945	1	0.482695	9.380423	2.276248	0.8	0.310507	0.075348
BSM	17.63	14.104	0.044945	1	0.343947	4.801065	0.655200	0.8	0.272324	0.037164
CALM	58.69	46.952	0.044945	1	0.321967	15.661778	1.860256	0.8	0.266856	0.031696
CF	107.373	85.896	0.044945	1	0.494922	33.721637	8.472539	0.8	0.314069	0.078910
CI	301.34	241.072	0.044945	1	0.267241	76.662444	5.799419	0.8	0.254405	0.019245
CSL	273.88	219.104	0.044945	1	0.305211	71.989296	7.583754	0.8	0.262850	0.027690
DIG	42.94	34.352	0.044945	1	0.704232	16.189409	6.091652	0.8	0.377024	0.141864
ED	84.87	67.896	0.044945	1	0.207839	20.672917	0.714912	0.8	0.243583	0.008424
ERX	66.37	53.096	0.044945	1	0.711636	25.172985	9.565434	0.8	0.379283	0.144123
EUO	34.41	27.528	0.044945	1	0.183209	8.266907	0.175061	0.8	0.240247	0.005088
EWV	21.81	17.448	0.044945	1	0.378152	6.133650	1.004817	0.8	0.281231	0.046071
GOGO	13.57	10.856	0.044945	1	0.503786	4.297139	1.106022	0.8	0.316665	0.081505
HDSN	8.01	6.408	0.044945	1	0.763522	3.164850	1.281220	0.8	0.395112	0.159953
HRB	41.02	32.816	0.044945	1	0.390116	11.667851	2.021600	0.8	0.284443	0.049283
HSN	35.55	28.440	0.044945	1	0.659718	12.921052	4.561124	0.8	0.363461	0.128302
HUDI	58.92	47.136	0.044945	1	1.377616	33.817026	19.961417	0.8	0.573948	0.338788

	Stock price	Strike price	Risk free rate	Time period	volatility	Call price	Put price	Strike to price	Call to price	Put to price
JAKK	18.78	15.024	0.044945	1	0.755675	7.375260	2.958961	0.8	0.392719	0.157559
LNG	175.79	140.632	0.044945	1	0.388281	49.915142	8.576418	0.8	0.283948	0.048788
MUSA	283.18	226.544	0.044945	1	0.324245	75.725746	9.133222	0.8	0.267412	0.032252
SRTS	13.16	10.528	0.044945	1	0.871809	5.632925	2.538223	0.8	0.428034	0.192874
TBT	38.26	30.608	0.044945	1	0.375972	10.737701	1.740491	0.8	0.280651	0.045491
TMV	175.67	140.536	0.044945	1	0.565985	58.871140	17.560635	0.8	0.335123	0.099964
TTT	99.96	79.968	0.044945	1	0.562354	33.390239	9.883675	0.8	0.334036	0.098876
TYO	14.77	11.816	0.044945	1	0.281966	3.804227	0.330918	0.8	0.257564	0.022405
UUP	30.11	24.088	0.044945	1	0.080390	7.080895	0.000236	0.8	0.235168	0.000008
YCS	67.41	53.928	0.044945	1	0.195375	16.299521	0.447404	0.8	0.241797	0.006637

We observe that for a call option with strike price 20% lower than the current asset price, the option price is more than 20% of the current asset price. This is reasonable since the call option is in the money and the option price must be higher than the asset price - strike price as of now.

The price of the put options are lower than the call options since the call options are out of the money.

The option price of a highly volatile asset is extremely expansive. For example, the price of the call option for HUDI is more than 50% of the current asset price and the price of the put option is more than 30% of the current asset price. This indicates the asset is a risky one. However, with great risk comes great reward. Since the asset only take a very small portion of our portfolio, we can afford the risk and aim for a return boost to our portfolio.