

```
In [2]: import matplotlib.pyplot as plt
import numpy as np

from black_scholes_merton import BSOption
from drawings import *
%load_ext autoreload
%autoreload 2
```

## Sample 1

### Step 1:

Issue / Calculation Date:	2020/12/31
Expiry Date:	2030/12/29
Time-to-expiry Factor:	100 %
Expected Expiry Date:	2030/12/29

### Step 2: Get All Default Values

Strike Price:	10.56
Pricing Date:	<input checked="" type="radio"/> Issue Date <input type="radio"/> Day Before <input type="radio"/> Average Days
Calculation Price:	10.560 <span>Reset Current Price</span>
% Interest Rate:	0.39 % <span>Reset Interest Rate</span> <a href="#">[ Interest Rates ]</a>
Volatility Calculation Type:	<input type="radio"/> Daily <input checked="" type="radio"/> Weekly <input type="radio"/> Monthly
Annualized Volatility:	0.2450843192 <span>Expected Term</span> <span>Reset Volatility</span> <span>Show Details</span>
Annual Dividend:	0 <span>Reset Dividend</span>

### Award Value: Get Award Value

Call Option Black-Scholes Value: 3.32965872  
 Put Option Black-Scholes Value: 2.92651355265125

```
In [3]: # spot, exercise, sigma, time, rate, dividend_rate = None
vars = [10.56, 10.56, .2450843192, 10, .0039, 0]
baseCall = 3.32965872

draw_both_tables(vars, baseCall)
```

## Input Values

	values
spot	10.56
exercise	10.56
sigma	0.2450843192
time	10
rate	0.0039
dividend_rate	0

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## Call and Put Prices

	Value	MRMG Value
Call	3.32966	3.32966
Call Diff (%)		-0.0%

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## Sample 2

**Step 1:**

Issue / Calculation Date: 2020/11/30  
 Expiry Date: 2030/11/28  
 Time-to-expiry Factor: 65 %

Please note that this Expiry Date is a "truncated" date that ignores the hours, minutes and seconds. Internal calculations in GEMSPM are more accurate as they consider the hours, minutes and seconds.

Expected Expiry Date: 2027/05/30

**Step 2:** Get All Default Values

Strike Price: 9.68

Pricing Date: ☒ Issue Date ☐ Day Before ☐ Average Days

Calculation Price: 9.680 Reset Current Price

% Interest Rate: 5 % Reset Interest Rate

Volatility Calculation Type: ☐ Daily ☐ Weekly ☒ Monthly

Annualized Volatility: 0.2439949672 Expected Term ▼ Reset Volatility Show Details

Annual Dividend: 0 Reset Dividend

**Award Value:** Get Award Value

Call Option Black-Scholes Value: 3.60688165  
 Put Option Black-Scholes Value: 0.976418882441624

```
In [4]: # spot, exercise, sigma, time, rate, dividend_rate = None
vars = [9.68, 9.68, .2439949672, 6.5, 0.05, 0]
baseCall = 3.60688165

draw_both_tables(vars, baseCall)
```

## Input Values

	values
spot	9.68
exercise	9.68
sigma	0.2439949672
time	6.5
rate	0.05
dividend_rate	0

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## Call and Put Prices

	Value	MRMG Value
Call	3.60688	3.60721
Call Diff (%)		0.01%

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## Sample 3

**Step 1:**

Issue / Calculation Date: 2020/12/31  
 Expiry Date: 2030/12/29  
 Time-to-expiry Factor: 100 %  
 Expected Expiry Date: 2030/12/29

**Step 2:**

Get All Default Values

Strike Price: 10.56

Pricing Date: ☒ Issue Date ☐ Day Before ☐ Average Days

Calculation Price: 10.560

% Interest Rate: 0.39 %  [\[ Interest Rates \]](#)

Volatility Calculation Type: ☐ Daily ☒ Weekly ☐ Monthly

Annualized Volatility: 0.2450843192

Annual Dividend: 0.480

**Award Value:**

Get Award Value

Call Option Black-Scholes Value: 1.17903666  
 Put Option Black-Scholes Value: 0.775891492651252

In [6]:

```
# spot, exercise, sigma, time, rate, dividend_rate = None
vars = [10.56, 10.56, .2450843192, 10, .0039, (.48/10.56)]
baseCall = 1.17903666

draw_both_tables(vars, baseCall)
```

**Input Values**

	values
spot	10.56
exercise	10.56
sigma	0.2450843192
time	10
rate	0.0039
dividend_rate	0.04545454545454545

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## Call and Put Prices

	Value	MRMG Value
Call	1.17904	1.17915
Call Diff (%)		0.01%

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## Sample 4

Expiry Date: 2030/11/28

Time-to-expiry Factor: 65 %

Please note that this Expiry Date is a "truncated" date that ignores the hours, minutes and seconds. Internal calculations in GEMS<sup>sm</sup> are more accurate as they consider the hours, minutes and seconds.

Expected Expiry Date: 2027/05/30

### Step 2: Get All Default Values

Strike Price: 10.56

Pricing Date: ☒ Issue Date ☐ Day Before ☐ Average Days

Calculation Price: 9.680

% Interest Rate: 5 %

Volatility Calculation Type: ☐ Daily ☐ Weekly ☒ Monthly

Annualized Volatility: 0.2439949672

Annual Dividend: 0.480

### Award Value: Get Award Value

Call Option Black-Scholes Value: 1.50659347

Put Option Black-Scholes Value: 0

```
In [7]: # spot, exercise, sigma, time, rate, dividend_rate = None
```

```
vars = [9.68, 10.56, .2439949672, 6.5, .05, (.48/9.68)]
baseCall = 1.50659347
```

```
draw_both_tables(vars, baseCall)
```

## Input Values

	values
spot	9.68
exercise	10.56
sigma	0.2439949672
time	6.5
rate	0.05
dividend_rate	0.049586776859504134

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## Call and Put Prices

	Value	MRMG Value
Call	1.50659	1.50672
Call Diff (%)		0.01%

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## Sample 5

Please note that this Expiry Date is a "truncated" date that ignores the hours, minutes and seconds. Internal calculations in GEMS<sup>pm</sup> are more accurate as they consider the hours, minutes and seconds.

Expected Expiry Date: 2027/05/30

## Step 2: [Get All Default Values](#)

Strike Price:

Pricing Date: ☒ Issue Date ☐ Day Before ☐ Average Days

Calculation Price:  [Reset Current Price](#)

% Interest Rate:  % [Reset Interest Rate](#) [\[ Interest Rates \]](#)

Volatility Calculation Type: ☐ Daily ☒ Weekly ☐ Monthly

Annualized Volatility:  [Expected Term](#) [Reset Volatility](#) [Show Details](#)

Annual Dividend:  [Reset Dividend](#)

## Award Value: [Get Award Value](#)

Call Option Black-Scholes Value: 0.99825754

Put Option Black-Scholes Value: 1.64787514377911

In [10]:

```
# spot, exercise, sigma, time, rate, dividend_rate = None
vars = [9.68, 10.56, .2640452644, 6.5, 0.0034, .48/9.68]
baseCall = .99825754

draw_both_tables(vars, baseCall)
```

## Input Values

	values
spot	9.68
exercise	10.56
sigma	0.2640452644
time	6.5
rate	0.0034
dividend_rate	0.049586776859504134

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## Call and Put Prices

	Value	MRMG Value
Call	0.99826	0.99836
Call Diff (%)		0.01%

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## Sample 6

Expiry Date: 2030/11/28

Time-to-expiry Factor: 65 %

Please note that this Expiry Date is a "truncated" date that ignores the hours, minutes and seconds. Internal calculations in GEMS<sup>sm</sup> are more accurate as they consider the hours, minutes and seconds.

Expected Expiry Date: 2027/05/30

### Step 2: Get All Default Values

Strike Price: 10.56

Pricing Date: ☒ Issue Date ☐ Day Before ☐ Average Days

Calculation Price: 9.680

% Interest Rate: 0.34 %  [\[ Interest Rates \]](#)

Volatility Calculation Type: ☒ Daily ☐ Weekly ☐ Monthly

Annualized Volatility: 0.2999199345

Annual Dividend: 0.480

### Award Value: Get Award Value

Call Option Black-Scholes Value: 1.25231855

Put Option Black-Scholes Value: 1.90193615377911

```
In [11]: # spot, exercise, sigma, time, rate, dividend_rate = None
```

```
vars = [9.68, 10.56, .2999199345, 6.5, 0.0034, .48/9.68]
baseCall = 1.25231855
```

```
draw_both_tables(vars, baseCall)
```

## Input Values

	values
spot	9.68
exercise	10.56
sigma	0.2999199345
time	6.5
rate	0.0034
dividend_rate	0.049586776859504134

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## Call and Put Prices

	Value	MRMG Value
Call	1.25232	1.25244
Call Diff (%)		0.01%

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# Sample 7

Expiry Date: 2030/11/28

Time-to-expiry Factor: 65 %

Please note that this Expiry Date is a "truncated" date that ignores the hours, minutes and seconds. Internal calculations in GEMSPM are more accurate as they consider the hours, minutes and seconds.

Expected Expiry Date: 2027/05/30

## Step 2:

Strike Price: 10.56

Pricing Date: ☒ Issue Date ☐ Day Before ☐ Average Days

Calculation Price: 9.680

% Interest Rate: 0.34 %  [\[ Interest Rates \]](#)

Volatility Calculation Type: ☐ Daily ☐ Weekly ☒ Monthly

Annualized Volatility: 0.2439949672 Expected Term

Annual Dividend: 0.480

## Award Value:

Call Option Black-Scholes Value: 0.85905204

Put Option Black-Scholes Value: 1.50866964377911

```
In [12]: # spot, exercise, sigma, time, rate, dividend_rate = None
vars = [9.68, 10.56, .2439949672, 6.5, 0.0034, .48/9.68]
baseCall = .85905204

draw_both_tables(vars, baseCall)
```

Input Values	
	values
spot	9.68
exercise	10.56
sigma	0.2439949672
time	6.5
rate	0.0034
dividend_rate	0.049586776859504134
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Call and Put Prices		
	Value	MRMG Value
Call	0.85905	0.85914
Call Diff (%)		0.01%
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In [ ]: