

**> # Derivation and examples single and multi period call pricing**

$$\mathbf{e1 := u*a + R*b = C[u];}$$

$$\mathbf{e2 := d*a + R*b = C[d];}$$

$$e1 := u a + R b = C_u$$

$$e2 := d a + R b = C_d$$

**> subs(solve({e1,e2},{a,b}));**

$$\left\{ b = \frac{u C_d - d C_u}{R(u-d)}, a = \frac{-C_d + C_u}{u-d} \right\}$$

**> C = subs(%,a+b);**

**C = simplify(rhs(%));**

$$C = \frac{-C_d + C_u}{u-d} + \frac{u C_d - d C_u}{R(u-d)}$$

$$C = \frac{-R C_d + R C_u + u C_d - d C_u}{R(u-d)}$$

**> qformula := (R-d)/(u-d);**

**Cformula := (1/R)\*(q\*C[u] + (1-q)\*C[d]);**

**C = Cformula;**

**subs(q=qformula,%);**

**simplify(%);**

$$qformula := \frac{R-d}{u-d}$$

$$Cformula := \frac{q C_u + (1-q) C_d}{R}$$

$$C = \frac{q C_u + (1-q) C_d}{R}$$

$$C = \frac{\frac{(R-d) C_u}{u-d} + \left(1 - \frac{R-d}{u-d}\right) C_d}{R}$$

$$C = \frac{-R C_d + R C_u + u C_d - d C_u}{R(u-d)}$$

**> params := {S=40,u=1.125,d=0.9,R=1.05, K=42};**

$$params := \{S = 40, u = 1.125, d = 0.9, R = 1.05, K = 42\}$$

**> qvalue := subs(params,qformula);**

*qvalue* := 0.666666667

**> Cvalue := subs(q=qvalue,Cformula);**

$$C_{value} := \frac{0.666666667 C_u + 0.333333333 C_d}{R}$$

**> C\_u\_value := eval(subs(params,max(u\*S-K,0)));**

**C\_d\_value := eval(subs(params,max(d\*S-K,0)));**

*C\_u\_value* := 3.000

*C\_d\_value* := 0

**> Cvalue := subs(C[u]=C\_u\_value,C[d]=C\_d\_value,Cvalue);**

$$C_{value} := \frac{2.000000000}{R}$$

**> Cvalue := subs(params,Cvalue);**

*Cvalue* := 1.904761905

**> # Exercise L10: 6 month call, delta t = 1 month r = 0.04**

**deltat\_value := evalf(1/12);**

**sigma\_value := 0.25;**

**u\_value := evalf(exp(sigma\_value\*sqrt(deltat\_value))); d\_value := evalf(1/u\_value);**

**r\_value := 0.04;**

**R\_value := 1.0 + deltat\_value\*r\_value;**

**params := {S=55, u = u\_value, d=d\_value, R = R\_value, K = 52};**

**qvalue := subs(params,qformula);**

**>**

*deltat\_value* := 0.08333333333

*sigma\_value* := 0.25

*u\_value* := 1.074836744

*d\_value* := 0.9303738503

*r\_value* := 0.04

*R\_value* := 1.003333333

*params* := {S = 55, K = 52, u = 1.074836744, R = 1.003333333, d = 0.9303738503}

*qvalue* := 0.5050396045

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> C_uuuuuu_value := eval(subs(params,max(((u^6)*S-K),0)));
C_uuuuud_value := eval(subs(params,max(((u^5)*(d)*S-K),0)));
C_uuuudd_value := eval(subs(params,max(((u^4)*(d^2)*S-K),0)));
C_uuuddd_value := eval(subs(params,max(((u^3)*(d^3)*S-K),0)));
C_uudddd_value := eval(subs(params,max(((u^2)*(d^4)*S-K),0)));
C_udddddd_value := eval(subs(params,max(((u)*(d^5)*S-K),0)));
C_dddddddd_value := eval(subs(params,max(((d^6)*S-K),0)));

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```
C_uuuuuu_value := 32.80426950
```

```
C_uuuuud_value := 21.40619412
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```
C_uuuudd_value := 11.54007143
```

```
C_uuuddd_value := 3.00000000
```

```
C_uudddd_value := 0
```

```
C_udddddd_value := 0
```

```
C_dddddddd_value := 0
```

```

> C_uuuuu_value :=
subs(params,subs(q=qvalue,C[u]=C_uuuuuu_value,C[d]=C_uuuuud_value,Cform
C_uuuud_value :=
subs(params,subs(q=qvalue,C[u]=C_uuuuud_value,C[d]=C_uuuudd_value,Cform
C_uuudd_value :=
subs(params,subs(q=qvalue,C[u]=C_uuuudd_value,C[d]=C_uuuddd_value,Cform
C_uuddd_value :=
subs(params,subs(q=qvalue,C[u]=C_uuuddd_value,C[d]=C_uudddd_value,Cform
C_udddd_value :=
subs(params,subs(q=qvalue,C[u]=C_uudddd_value,C[d]=C_udddddd_value,Cform
C_dddddd_value :=
subs(params,subs(q=qvalue,C[u]=C_udddddd_value,C[d]=C_dddddddd_value,Cform

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```
C_uuuuu_value := 27.07243217
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```
C_uuuud_value := 16.46796093
```

```
C_uuuudd_value := 7.288778372
```

```
C_uuuddd_value := 1.510085197
```

```
C_uuddd_value := 0.
```

```
C_udddd_value := 0.
```

```

> C_uuuu_value :=
subs(params,subs(q=qvalue,C[u]=C_uuuuu_value,C[d]=C_uuuud_value,Cformu

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C_uuud_value :=
subs(params,subs(q=qvalue,C[u]=C_uuuud_value,C[d]=C_uuudd_value,Cformu
C_uudd_value :=
subs(params,subs(q=qvalue,C[u]=C_uuudd_value,C[d]=C_uuddd_value,Cformul
C_uddd_value :=
subs(params,subs(q=qvalue,C[u]=C_uuddd_value,C[d]=C_udddd_value,Cformul
C_dddd_value :=
subs(params,subs(q=qvalue,C[u]=C_udddd_value,C[d]=C_ddddd_value,Cformul:

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C_uuuu_value := 21.75113512
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C_uuud_value := 11.88501240
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```
C_uudd_value := 4.413841309
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```
C_uddd_value := 0.7601191006
```

```
C_dddd_value := 0.
```

```

> C_uuu_value :=
subs(params,subs(q=qvalue,C[u]=C_uuuu_value,C[d]=C_uuud_value,Cformula)
C_uud_value :=
subs(params,subs(q=qvalue,C[u]=C_uuud_value,C[d]=C_uudd_value,Cformula)
C_udd_value :=
subs(params,subs(q=qvalue,C[u]=C_uudd_value,C[d]=C_uddd_value,Cformula).
C_ddd_value :=
subs(params,subs(q=qvalue,C[u]=C_uddd_value,C[d]=C_dddd_value,Cformula))

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```
C_uuu_value := 16.81175594
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```
C_uud_value := 8.159879008
```

```
C_udd_value := 2.596737728
```

```
C_ddd_value := 0.3826148671
```

```

> C_uu_value :=
subs(params,subs(q=qvalue,C[u]=C_uuu_value,C[d]=C_uud_value,Cformula));
C_ud_value :=
subs(params,subs(q=qvalue,C[u]=C_uud_value,C[d]=C_udd_value,Cformula));
C_dd_value :=
subs(params,subs(q=qvalue,C[u]=C_udd_value,C[d]=C_ddd_value,Cformula));

```

```
C_uu_value := 12.48779354
```

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C_ud_value := 5.388383125
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```
C_dd_value := 1.495848440
```

```
> C_u_value :=  
  subs(params,subs(q=qvalue,C[u]=C_uu_value,C[d]=C_ud_value,Cformula));  
C_d_value :=  
  subs(params,subs(q=qvalue,C[u]=C_ud_value,C[d]=C_dd_value,Cformula));
```

```
C_u_value := 8.944053047
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C_d_value := 3.450231846
```

```
> C_value :=  
  subs(params,subs(q=qvalue,C[u]=C_u_value,C[d]=C_d_value,Cformula));
```

```
C_value := 6.204148639
```

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>
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