```
Exit[]

$Assumptions = μ ≥ 0 && σ > 0 && a ∈ Reals && 1 > k1 ≥ 0 &&
   k0 ≥ 0 && S0 > 0 && K > 0 && r ≥ 0 && b ∈ Reals && rf ≥ 0 && γ > 0;
u[W_] := Exp[-γ W]
pr[B_] := e^(-B^2/2) / Sqrt[2 π]
xx[B_] := S0 Exp[ σ Sqrt[t] B + (μ - σ^2 / 2) t];
NIntegrate[xx[B] pr[B], {B, -∞, ∞}] - S0
```

NIntegrate::inumr :

The integrand $\frac{e^{-\frac{B^2}{2}+B\sqrt{t}\ \sigma+t\left(\mu-\frac{\sigma^2}{2}\right)}\ S0}{\sqrt{2\pi}}$ has evaluated to non-numerical values for all sampling points in the region with boundaries {{−∞, 0.}}. ≫

```
-S0 + NIntegrate[xx[B] pr[B], {B, -∞, ∞}]
```

Short put

```
γ = .01; μ = 0; t = 1; k = 550; S0 = 600; σ = .25;
put[W_] := Max[0, k - W]
FinancialDerivative[{"European", "Put"}, {"StrikePrice" → k, "Expiration" → t},
 {"InterestRate" → 0.0, "Volatility" → σ, "CurrentPrice" → S0, "Dividend" → 0}]
p = NIntegrate[put[xx[B]] pr[B], {B, -∞, ∞}]

q = Log[NIntegrate[u[-put[xx[B]]] pr[B], {B, -∞, ∞}]] / γ

35.6083

35.6083

58.5032
```

Revision

```
γ = .01; k = 550; S0 = 600; σSqrtT = .25;

p0 = FinancialDerivative[{"European", "Put"}, {"StrikePrice" → k, "Expiration" → 1},
   {"InterestRate" → 0, "Volatility" → σSqrtT, "CurrentPrice" → S0}];

density[B_] := e^(-B^2/2) / Sqrt[2 π]
put[B_] := Max[0, k - S0 Exp[ σSqrtT B - σSqrtT^2 / 2]]
p1 = NIntegrate[put[B] density[B], {B, -∞, ∞}];
p2 = 1 / γ Log[NIntegrate[Exp[γ put[B]] density[B], {B, -∞, ∞}]];
{p0, p1, p2}

{35.6083, 35.6083, 58.5032}
```

Marginal utility-based price

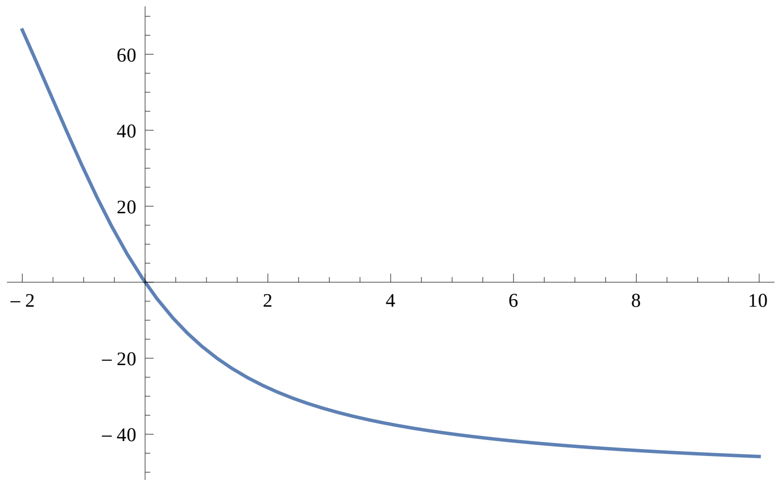
```
μT = -0.08;
put[B_] := Max[0, k - S0 Exp[ σSqrtT B + μT - σSqrtT^2 / 2]]
pP = NIntegrate[put[B] density[B], {B, -∞, ∞}]

pP0 = FinancialDerivative[{"European", "Put"}, {"StrikePrice" → k, "Expiration" → 1},
  {"InterestRate" → 0, "Dividend" → -μT, "Volatility" → σSqrtT, "CurrentPrice" → S0}]
g[v_] := -1/γ Log[NIntegrate[Exp[-γ v put[B]] density[B], {B, -∞, ∞}]];
```

52.9911

52.9911

```
Plot[{g[v] / v - pP}, {v, -2, 10}]
```



Marginal utility-based price

```
μT = 0;
put[B_] := Max[0, k - S0 Exp[ σSqrtT B + μT - σSqrtT^2 / 2]]
pP = NIntegrate[put[B] density[B], {B, -∞, ∞}]

pP0 = FinancialDerivative[{"European", "Put"}, {"StrikePrice" → k, "Expiration" → 1},
  {"InterestRate" → 0, "Dividend" → -μT, "Volatility" → σSqrtT, "CurrentPrice" → S0}]
g[v_, b_] := 1/γ Log[NIntegrate[Exp[-γ (b - v put[B])] density[B], {B, -∞, ∞}]];
dg[v_, b_] := NIntegrate[Exp[-γ (b - v put[B])] (put[B] - b) density[B], {B, -∞, ∞}];
dg2[v_] := NIntegrate[Exp[-γ (-v put[B])] put[B] density[B], {B, -∞, ∞}];
{pR = g[1, 0], dg2[1] / Exp[γ pR]}
v2 = 7; pR2 = g[v2, 0]; {pR2 / v2, dg2[v2] / Exp[γ pR2]}
```

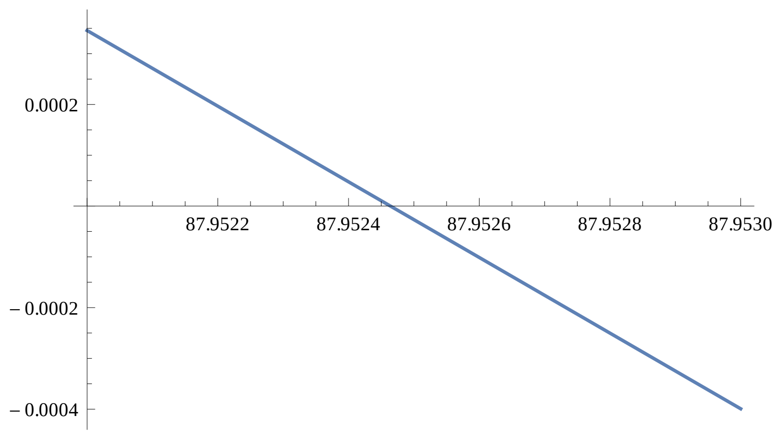
35.6083

35.6083

{58.5032, 87.9525}

{217.181, 327.148}

```
Plot[{dg[1, b]}, {b, 87.952, 87.953}]
```



```
Plot[g[1 - v, 0] - pR + {v 87.952, v 87.953}, {v, -0.000001, 0.000001}]
```