```
Exit[]

PrependTo[$Path, "/home/data/promotion/Mathematica/Packages"]; << JoFin`

$Assumptions = μ > 0 && σ > 0 && a ∈ Reals && 1 > k1 ≥ 0 &&
    k0 ≥ 0 && S0 > 0 && K > 0 && r ≥ 0 && b ∈ Reals && rf ≥ 0 && γ > 0;

t == σ √T ; mpr == (μ - r)/σ² ; ost =.

xx[W_, mpr_, t_] := Exp[ t W + (mpr - 1 / 2) t²];
put[k_, t_] := BlackScholesPut[1, k, 1, 0, t, 0]

γ = .1; mpr = 0.1; t = 1;

NIntegrate[Max[0, 1.1 - xx[w, 0, .1]] Exp[-w² / 2], {w, -∞, ∞}]/ √(2 π) - put[1.1, .1]


pr[a_, k_] :=
    -Log[NIntegrate[Exp[-a Max[0, k - xx[w, mpr, t]] - w² / 2], {w, -∞, ∞}]/ √(2 π) ] -
    a put[k, t];
pr2[a_, k_] := NIntegrate[Exp[-a (Max[0, k - xx[w, mpr, t]] - put[k, t]) - w² / 2]
    (Max[0, k - xx[w, mpr, t]] - put[k, t]), {w, -∞, ∞}];

-5.88141 × 10⁻¹⁴

mpr = -.15; Plot[{pr[a, 2], pr2[a, 2]}, {a, -1, 1}, PlotRange → {-.1, .1}]
```
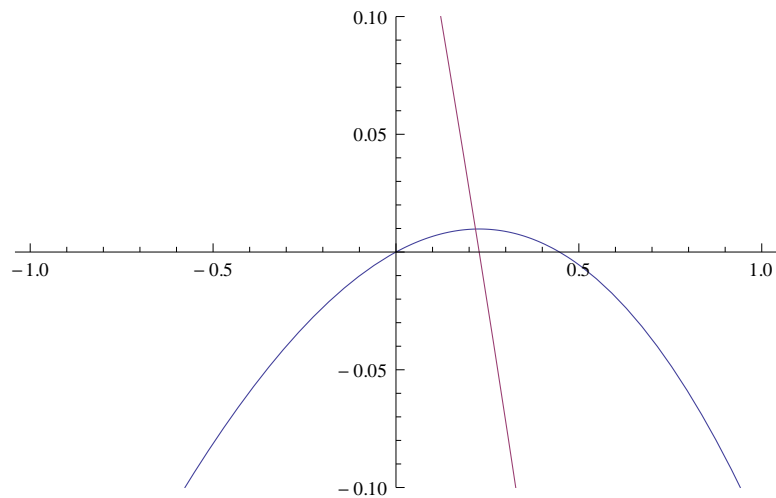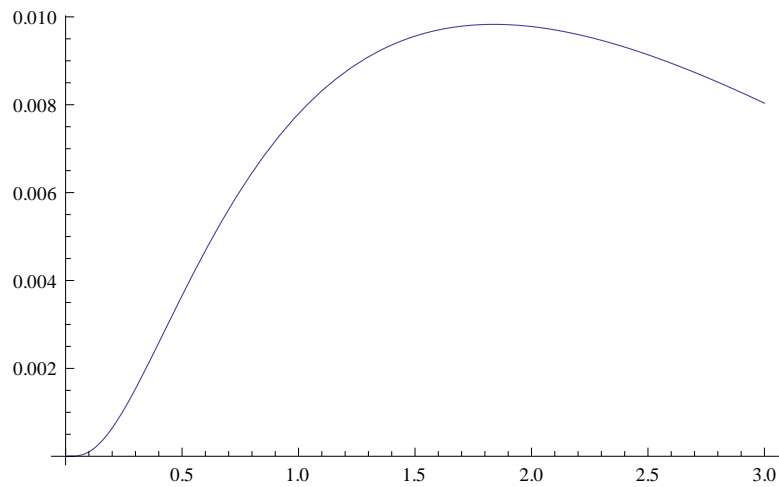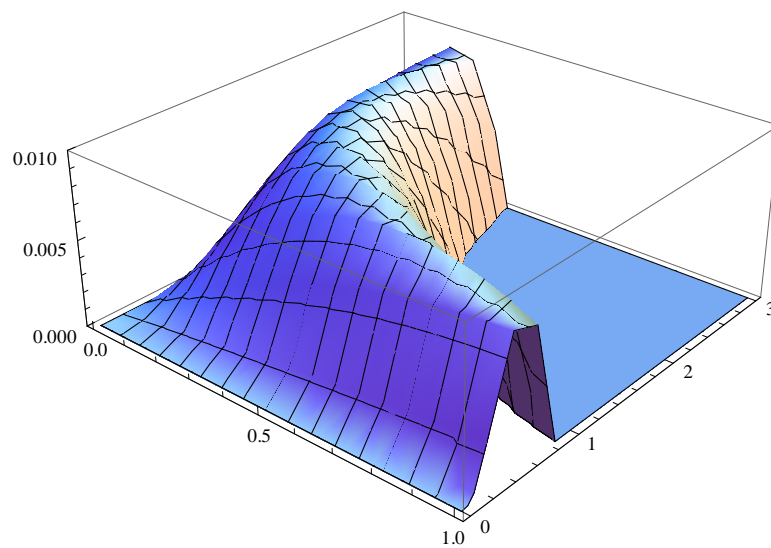
mpr = -.15; Plot[{pr[.23, k]}, {k, 0, 3}]

Quiet[FindRoot[pr2[a, 1.9] == 0, {a, -1, 1}]]

$\{a \to 0.23679\}$

Plot3D[pr[a, k], {a, 0, 1}, {k, 0, 3}, PlotRange → {0, .01}]

Normal[Series[df[a, w, 0, t], {t, 0, 3}]]

$$-e^{-\frac{w^2}{2}} t\, w + \frac{1}{2}\, e^{-\frac{w^2}{2}}\, t^2\, \left(1 - 2\, \text{mpr} - w^2 + 2\, a\, w^2\right) -$$

$$\frac{1}{6}\, e^{-\frac{w^2}{2}}\, t^3\, w\, \left(-3 + 6\, a + 6\, \text{mpr} - 12\, a\, \text{mpr} + w^2 - 6\, a\, w^2 + 3\, a^2\, w^2\right)$$

Integrate[, {w, -∞, ∞}]

$$\sqrt{\frac{\pi}{2}}\, \left(2 + a\, t\, \left(2\, b + 3\, (-1 + a)\, b^2\, t + (a - 2\, \text{mpr})\, t\right)\right)$$

MinValue $\left[\sqrt{\dfrac{\pi}{2}}\ \left(2 + a\,t\,\left(2\,b + 3\,(-1 + a)\,b^2\,t + (a - 2\,mpr)\,t\right)\right), \{a\}\right]$

$$\begin{cases} \sqrt{2\,\pi} & (b > 0\ \&\&\ t == 0)\ ||\ (b < 0\ \&\&\ t == 0) \\[4pt] \dfrac{1}{4}\,\left(4\,\sqrt{2\,\pi} - 2\,mpr^2\,\sqrt{2\,\pi}\ t^2\right) & b == 0 \\[4pt] \dfrac{1}{4 + 12\,b^2}\,\Big(4\,\sqrt{2\,\pi} + 10\,b^2\,\sqrt{2\,\pi}\ + & \text{True} \\[8pt] \qquad 6\,b^3\,\sqrt{2\,\pi}\ t + 4\,b\,mpr\,\sqrt{2\,\pi}\ t - 9\,b^4\,\sqrt{\dfrac{\pi}{2}}\ t^2 - \\[8pt] \qquad 6\,b^2\,mpr\,\sqrt{2\,\pi}\ t^2 - 2\,mpr^2\,\sqrt{2\,\pi}\ t^2\Big) \end{cases}$$

Series[%, {t, 0, 2}]

$\sqrt{2\,\pi}\ + a\,b\,\sqrt{2\,\pi}\ t + \left(a^2 - 3\,a\,b^2 + 3\,a^2\,b^2 - 2\,a\,mpr\right)\,\sqrt{\dfrac{\pi}{2}}\ t^2 + O[t]^3$

Integrate $\left[\textbf{SeriesCoefficient}\left[\textbf{df}\left[\textbf{a, w, b}\,\sqrt{\textbf{t}}\ \textbf{, t}\right]\textbf{, \{t, 0, 2\}}\right]\textbf{, \{w, -}\infty\textbf{, }\infty\textbf{\}}\right]$

$\dfrac{1}{4}\,\left(8\,a + 35\,(-1 + 2\,(-1 + a)\,a\,(-7 + 2\,a))\,b^4 - 8\,mpr\right)\,\sqrt{\dfrac{\pi}{2}}$

SeriesCoefficient[df[a, w, b, t], {t, 0, 2}]

$a\,e^{a\,\left(1 - e^{-2.4\,w^2}\right) - 5.3\,w^2}\,w^2 - \dfrac{1}{2}\,e^{a\,\left(1 - e^{-2.4\,w^2}\right) - 2.9\,w^2}\,\left(-1 + 2\,mpr + w^2\right) +$

$\qquad \dfrac{1}{2}\,e^{a\,\left(1 - e^{-2.4\,w^2}\right) - \frac{w^2}{2}}\,\left(1 - e^{-2.4\,w^2}\right)\,\left(a^2\,e^{-4.8\,w^2}\,w^2 - a\,e^{-2.4\,w^2}\,\left(-1 + 2\,mpr + w^2\right)\right)$

$\dfrac{1}{2}\,(-1 + 2\,a)\,e^{-\frac{w^2}{2}}\,t^2\,w^2 - \dfrac{1}{6}\,\left(1 - 6\,a + 3\,a^2\right)\,e^{-\frac{w^2}{2}}\,t^3\,w^3$

$\dfrac{1}{2}\,(-1 + 2\,a)\,e^{-\frac{w^2}{2}}\,t^2\,w^2 - \dfrac{1}{6}\,\left(1 - 6\,a + 3\,a^2\right)\,e^{-\frac{w^2}{2}}\,t^3\,w^3$

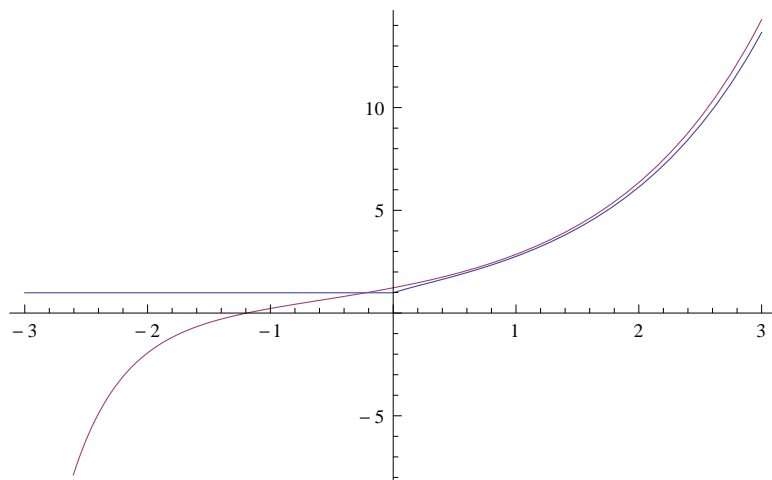**ost = .01; mpr = 0.5; b = 2.4; o = -0 3; p = 3; Plot[{g[Max[0, a], ∞], g[a, b]}, {a, o, p}]**
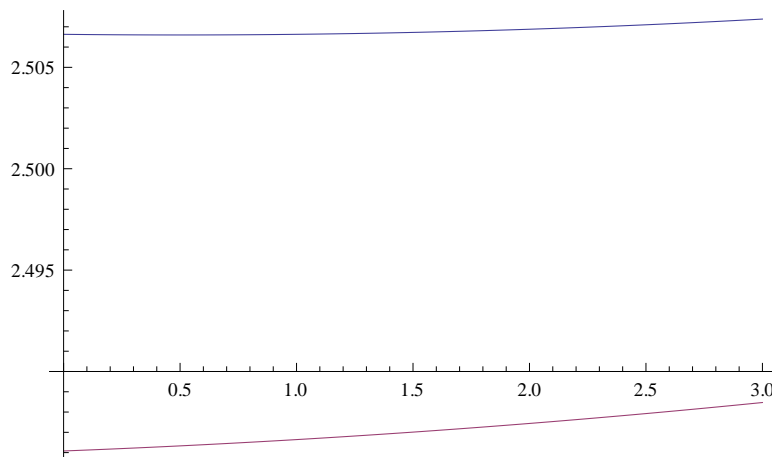
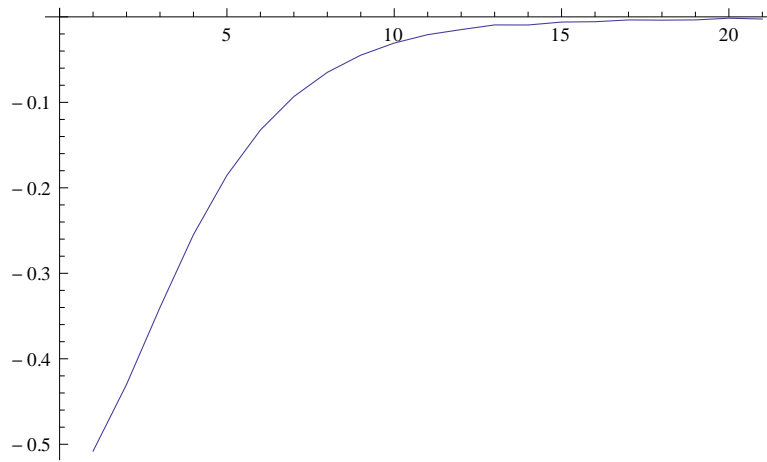**ost = .0001; b = 2.4; o = -1 0; p = 3; Plot[{dg[Max[0, a], ∞]}, {a, o, p}]**
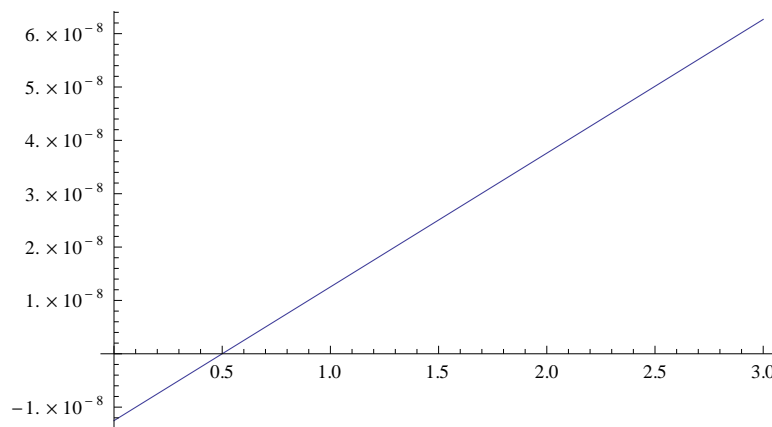
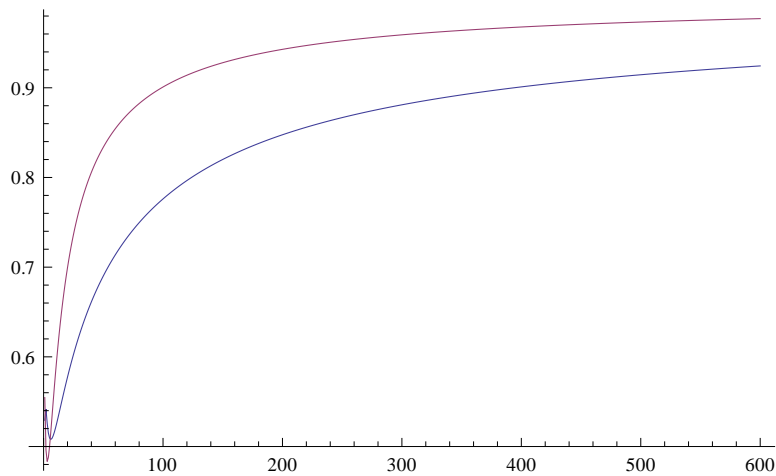**b = .1; o = -3; p = 3; Plot[{dg[Max[0, a], 0], dg[a, b]}, {a, o, p}]**

h[b_] := Quiet[FindRoot[dg[a, b] == 0, {a, -5, 5}][[1, 2]]]

```
ListLinePlot[Table[h[1 / n / 2], {n, 10, 30}]]
```



```
fcs = Quiet[Table[fc2[n], {n, 650}]];
```

$$\texttt{ListLinePlot}\Big[$$
$$\texttt{Transpose}\Big[\texttt{Table}\Big[\big\{\texttt{Abs[fcs[[n]]]}^{1/n}, \texttt{Abs[fcs[[n+1]] / fcs[[n]]]}\big\}, \{n, 1, 600\}\Big]\Big]\Big]$$


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Exit[]
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$$\texttt{Simplify}\Big[-\texttt{Log}\Big[\texttt{Integrate}\Big[\texttt{Exp}\big[\mu\, w - w^2 \big/\, 2\big], \{w, -\infty, \infty\}\Big]\Big/ \sqrt{2\, \pi}\,\Big]\Big/\, \gamma\Big]$$

$$-\frac{\mu^2}{2\,\gamma}$$