

Homework #1

Astronomy 600

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Note: You will need Julia v1.9 to run this notebook.

```
using Integrals  
  
using Plots  
using LaTeXStrings
```

Integral

$$\int_0^z \frac{dz}{[\Omega(1+z)^3 + (1-\Omega)(1+z)^{3/2}]^{1/2}}$$

Function definition

```
f(z, Ω) = (Ω*(1+z)^3 + (1-Ω)*(1+z)^(3/2))^(1/2)
```

f (generic function with 1 method)

```
Ω = 0  
prob = IntegralProblem(f, 0, 1, Ω)  
sol = solve(prob, QuadGKJL()).u
```

0.7568284600108843

```
integral(z, Ω) = solve(IntegralProblem((z, Ω) → f(z, Ω), 0.0, z, Ω), QuadGKJL()).u
```

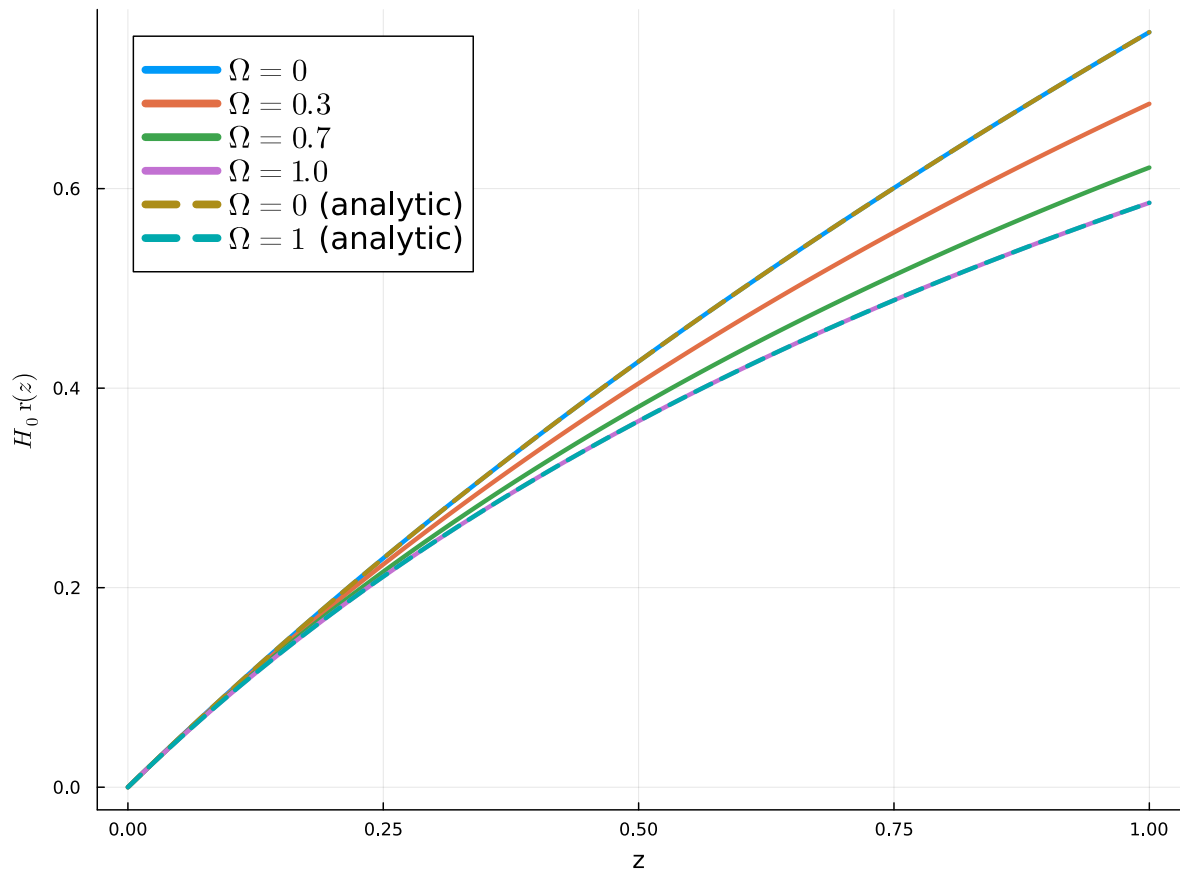
integral (generic function with 1 method)

Plot

```
z = 0:0.01:1.0
y = [integral.(z, Ω) for Ω in [0, 0.3, 0.7, 1.0]]

A_Ω0(z) = 4*(1+z)^(1/4) - 4
A_Ω1(z) = -2/(1+z)^(1/2) + 2

plot(legendfontsize=14, dpi=150; size=(800,600),
      xlabel="z", ylabel=L"H_0 \; \mathrm{r}(z)")
plot!(z, y,
      label=[L"\Omega=0" L"\Omega=0.3" L"\Omega=0.7" L"\Omega=1.0"], linewidth=3)
plot!(z, A_Ω0.(z), line=:dash, linewidth=3, label=L"\Omega=0"*" (analytic)")
plot!(z, A_Ω1.(z), line=:dash, linewidth=3, label=L"\Omega=1"*" (analytic)")
```



```
savefig("plot.png");
```