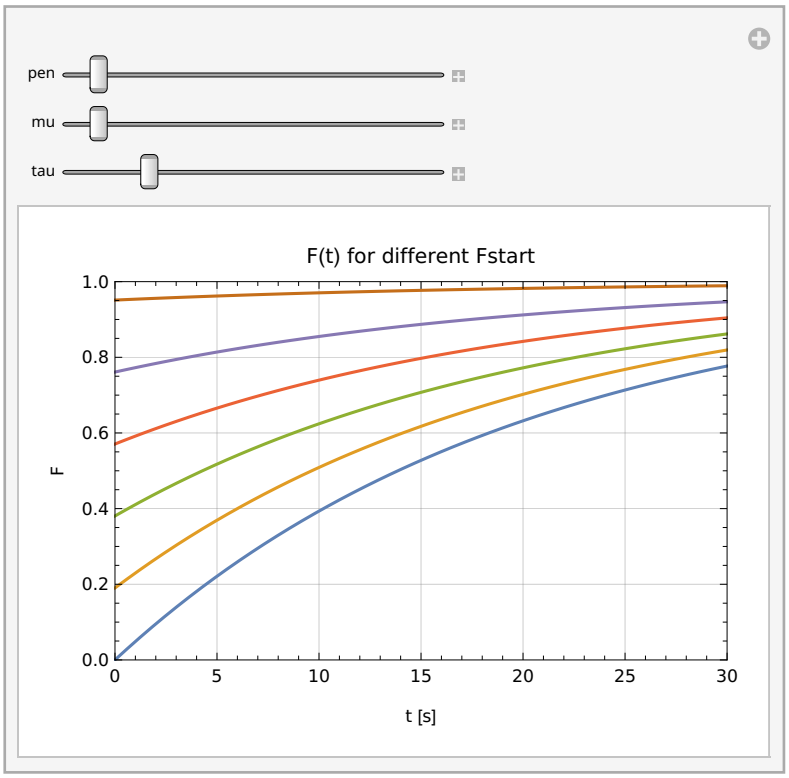
`computeTaskFatigue()` A - Jaber

In[1]:=
```
FatigueWrest[t_, Fstart_, p_, R_] := R + (1 - E^(-t*p)) (1 - R)
ResidualFatigue[τ_, F_, μ_] := F E^(-μ τ)
```

In[3]:=
```
Flist = Range[0, 1, 0.2];
Manipulate[
 Plot[Evaluate@Table[FatigueWrest[t, Fstart, pen, ResidualFatigue[tau, Fstart, mu]],
    {Fstart, Flist}], {t, 0, 30}, PlotRange → {{0, 30}, {0, 1}},
  Frame → True, GridLines → Automatic,
  FrameLabel → {"t [s]", "F"}, PlotLabel → "F(t) for different Fstart"],
 {{pen, 0.05}, 0, 1},
 {{mu, 0.05}, 0, 1},
 {{tau, 1}, 0, 5}]
```

Out[4]=

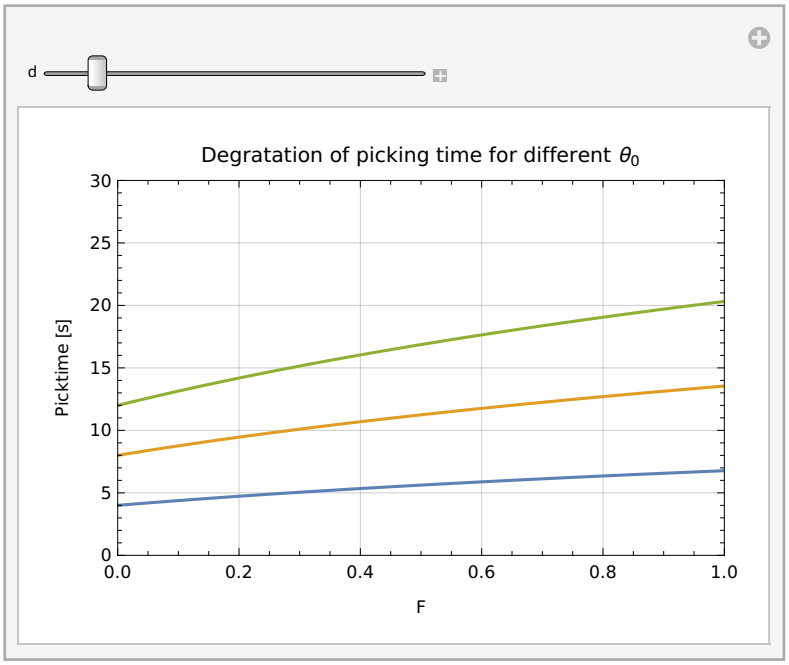


`computePickTime` A - Ferjani

In[5]:=
```
PickTime[Fatigue_, Time0_, δ_] := Time0 (1 + δ Log[1 + Fatigue])
```

In[6]:=
```
t0list = {4, 8, 12};
Manipulate[
 Plot[Evaluate@Table[PickTime[f, t0, d], {t0, t0list}],
  {f, 0, 1}, PlotRange → {{0, 1}, {0, 30}},
  Frame → True, GridLines → Automatic, FrameLabel → {"F", "Picktime [s]"},
  PlotLabel → "Degratation of picking time for different θ0"],
 {{d, 1}, 0, 10}
]
```

Out[7]=

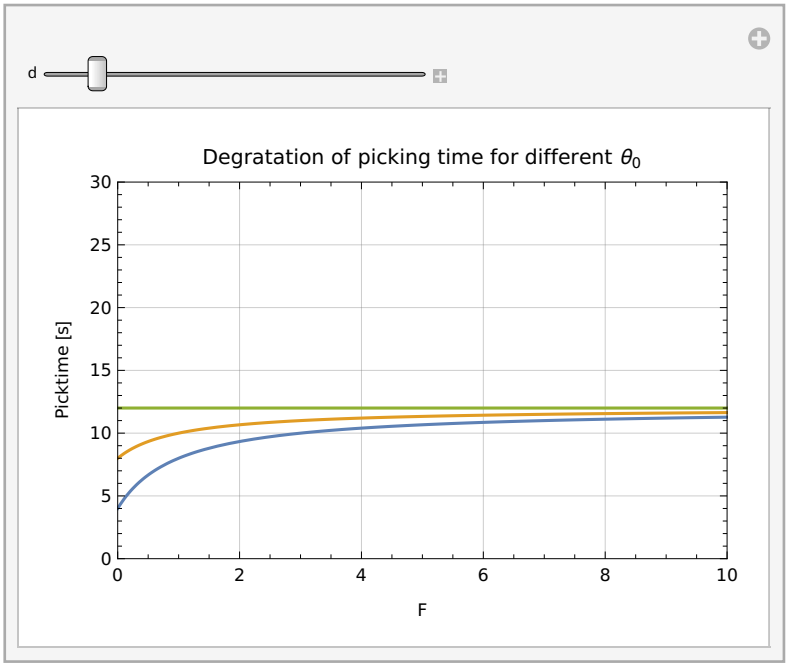


(extra) - `computePickTime` B - Mummolo

In[8]:=
```
TimeInc[Fatigue_, Time0_, δ_, Max_] := Time0 + (Max - Time0) (1 - (1 + Fatigue)^-δ)
```

In[9]:=
```
t0list = {4, 8, 12};
Manipulate[
 Plot[Evaluate@Table[TimeInc[f, t0, d, 12], {t0, t0list}],
  {f, 0, 10}, PlotRange → {{0, 10}, {0, 30}},
  Frame → True, GridLines → Automatic, FrameLabel → {"F", "Picktime [s]"},
  PlotLabel → "Degratation of picking time for different θ0"],
 {{d, 1}, 0, 10}
]
```

Out[10]=



Time to reach a certain fatigue level

`computeRecoveryLevel()` A - Ferjani

In[11]:=
```
ResidualFatigue[τ, F, μ]
```

Out[11]= $e^{-\mu \tau}$ F

`computeRestTime()` A - Ferjani

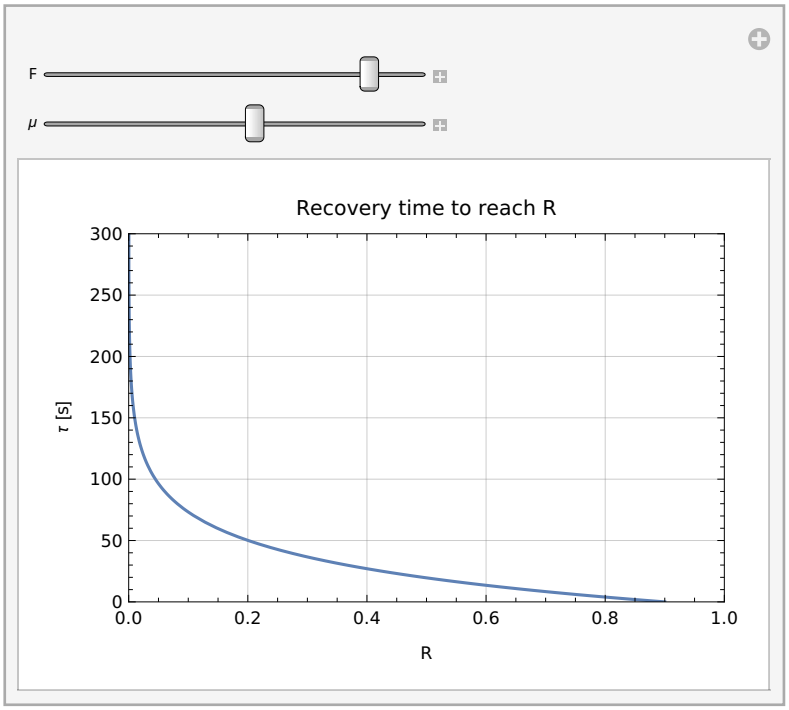
In[12]:=
```
Solve[ResidualFatigue[τ, F, μ] == Rlow,
 τ ∈ Reals, Assumptions → Rlow < F && F > 0 && μ > 0 && Rlow > 0]
```

Out[12]=
$$\left\{\left\{\tau \to \frac{\text{Log}\left[\frac{F}{\text{Rlow}}\right]}{\mu} \text{ if } \text{Rlow} < F\right\}\right\}$$

In[13]:=
```
tauToRlow[Rlow_, F_, μ_] := Log[F/Rlow]/μ
```

In[14]:=
```
Manipulate[
 Plot[tauToRlow[Rlow, F, μ], {Rlow, 0, F}, Frame → True, GridLines → Automatic,
  FrameLabel → {"R", "τ [s]"}, PlotLabel → "Recovery time to reach R",
  PlotRange → {{0, 1}, {0, 300}}],
 {{F, .9}, 0.1, 1}, {{μ, 0.03}, 0.005, 0.05}
]
```

Out[14]=



Parameters from the literature

In[15]:=
```
penibilities = {0.1, 0.35, 0.8,  (* range .1 to .8 for Ferjani *)
    0.0064, 0.0096,  (*for Meentzen *)
    0.01, 0.03, 0.05 ,  (* for Jaber*)
    1 * 10^-4, 8 * 10^-4, 15 * 10^-4 (* range 1 to 15 *10^-4 for Asadayoobi*)
   };
restrates = {
    0.0064, 0.0096,  (*for Meentzen *)
    0.03, 0.05, 0.07 ,  (* for Jaber*)
    5 * 10^-4, 7 * 10^-4, 9 * 10^-4 (* range 5 to 9 *10^-4 for Asadayoobi*)
   };
corrfactors =
   {0.3 / 0.4 * Log[2], 0.7 / 0.4 * Log[2],  (* 0.3 or 0.7 / p * ln(2) for Ferjani *)
    100 * 7 * 10^-4, 350 * 7 * 10^-4(* 100 to 350 / p for Asadayoobi*)
   };
```

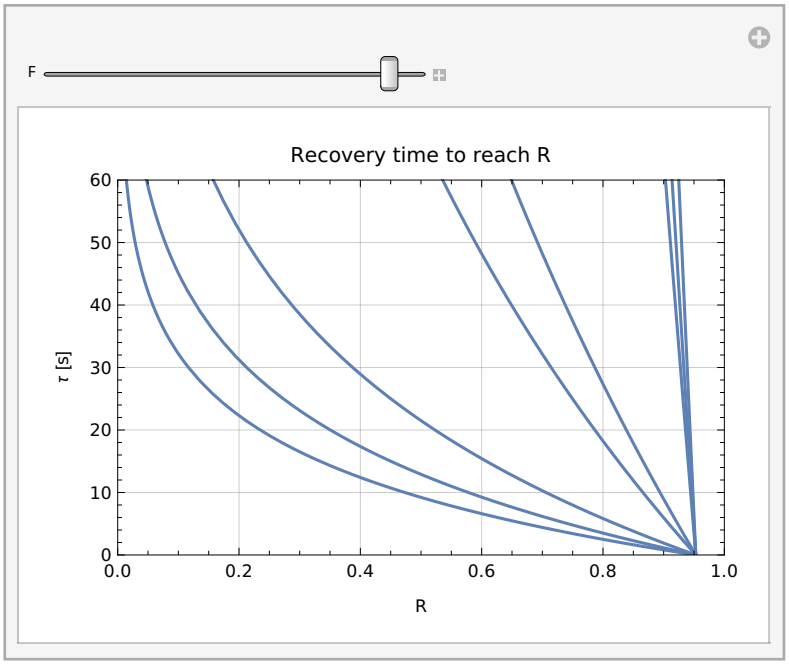
Recovery time to reach Rlow

In[18]:=
```
N@restrates
```

Out[18]=
```
{0.0064, 0.0096, 0.03, 0.05, 0.07, 0.0005, 0.0007, 0.0009}
```

In[19]:=
```
Manipulate[
 Plot[Table[tauToRlow[Rlow, F, restrate], {restrate, restrates}],
  {Rlow, 0, F}, Frame → True, GridLines → Automatic,
  FrameLabel → {"R", "τ [s]"}, PlotLabel → "Recovery time to reach R",
  PlotRange → {{0, 1}, {0, 60}}],
 {{F, .9}, 0.1, 1}
]
```

Out[19]=



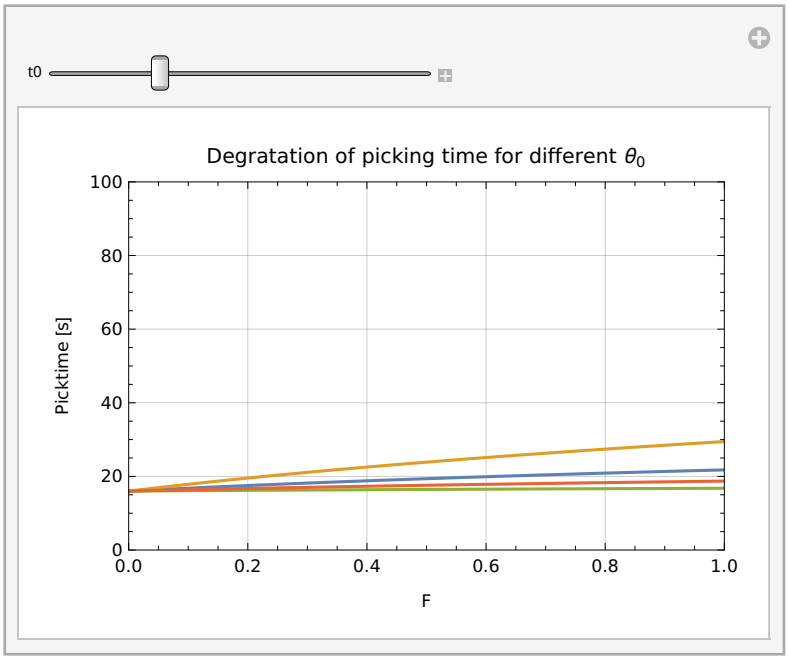
Time correction factor

In[20]:=
```
N@corrfactors
```

Out[20]=
```
{0.51986, 1.21301, 0.07, 0.245}
```

In[21]:=
```
t0list = {4, 8, 12};
Manipulate[
 Plot[Evaluate@Table[PickTime[f, t0, d], {d, corrfactors}],
  {f, 0, 1}, PlotRange → {{0, 1}, {0, 100}},
  Frame → True, GridLines → Automatic, FrameLabel → {"F", "Picktime [s]"},
  PlotLabel → "Degratation of picking time for different θ0"],
 {{t0, 10}, 0, 60}
]
```

Out[22]=



Fatigue build-up

In[23]:=
```
N@penibilities
```

Out[23]=
```
{0.1, 0.35, 0.8, 0.0064, 0.0096, 0.01, 0.03, 0.05, 0.0001, 0.0008, 0.0015}
```

In[24]:=
```
Manipulate[
 Plot[Evaluate@Table[FatigueWrest[t, Fstart, pen, ResidualFatigue[tau, Fstart, mu]],
    {pen, penibilities}], {t, 0, 30}, PlotRange → {{0, 30}, {0, 1}},
  Frame → True, GridLines → Automatic,
  FrameLabel → {"t [s]", "F"}, PlotLabel → "F(t) for different Fstart"],
 {Fstart, 0, 1},
 {mu, 0, 1},
 {{tau, 1}, 0, 5}]
```

Out[24]=