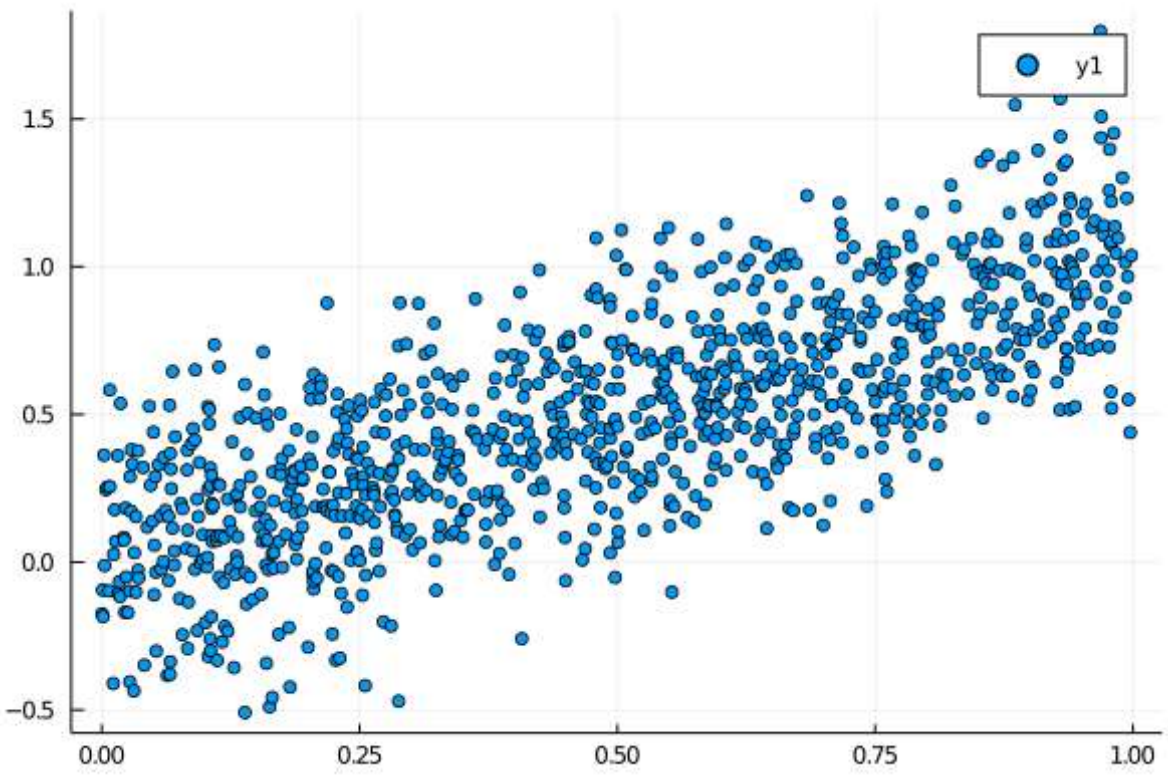
Problem 4 - via Julia

In [1]:
```
using LinearAlgebra, Plots
default(fmt = :png)
```

In [2]:
```
# 1)
n = 1000
x = rand(n)                                  # uniform over [0,1]
ϵ = 0.25 .* randn(n)                         # standardnormal * 0.25
y = x + ϵ
p = sortperm(x)                              # sort series data
x, y = x[p], y[p]
fig = scatter(x, y)
```

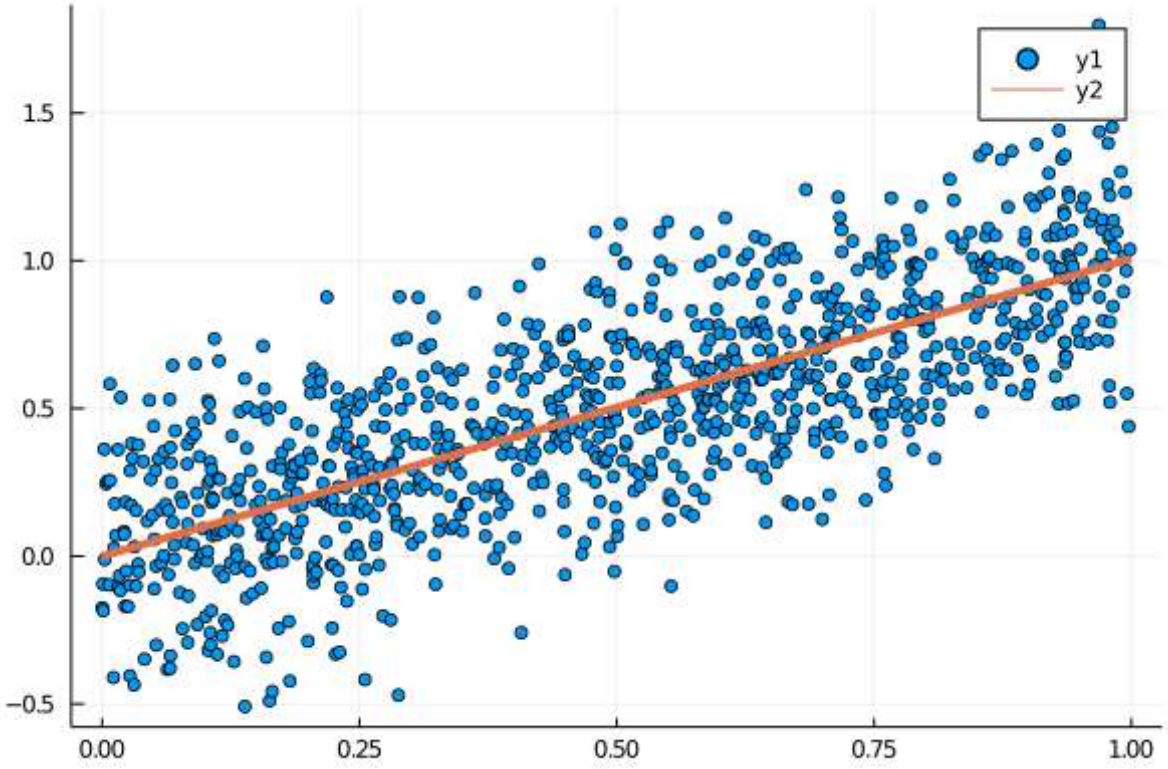
Out[2]:



In [3]:
```
# 2)
f(a) = sum(@. (x * a - y)^2)
Df(a) = sum(@. 2 * x * (x * a - y))
DDf = sum(@. 2 * x^2)
a, h = 0.5, 0
f_new, f_old = f(a), Inf
while f_old - f_new > eps()                  # simple newton-method
    h = -Df(a)/DDf
    @show a = a + h
    f_old = f_new
    @show f_new = f(a)
end
fig = plot!(0:0.5:1, x -> a*x, linewidth=4)
```

```
a = a + h = 1.007673435466103
f_new = f(a) = 63.34783231789271
a = a + h = 1.007673435466103
f_new = f(a) = 63.34783231789271
```

Out[3]:



In [6]:

```
# 4)
d = 4
ϵ = 0.01 .* randn(n)
y = @. 30 * (x - .25)^2 * (x - .75)^2 + ϵ
fig2 = scatter(x, y)
X = [x.^m for m in 1:d]
X = hcat(ones(n), X...)
a = (X'X) \ (X'y)
fig2 = plot!(0:0.05:1, x -> sum(a[i+1] * x^(i) for i in 0:d), linewidth=4)
```

Out[6]: