# Lab 3: Depth-Damage Models

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```julia
using CSV
using DataFrames
using DataFramesMeta
using Distributions
using Interpolations
using Plots
using StatsPlots
using Unitful

Plots.default(; margin=6Plots.mm)
```

## Site information

Location : 29°18'33"N 94°47'34"W

Elevation (From Google Earth): 1.17m

## Depth-Damage

Code below gets Depth Damage Function

```julia
# Grabbing Depth Damage
haz_fl_dept = CSV.read("data/haz_fl_dept.csv", DataFrame)
include("depthdamage.jl")
```

```
DepthDamageData
```

```julia
data_row = @rsubset(
    haz_fl_dept, :Description == "two story, no basement, Contents", :Source ==
"USACE - Galveston"
)[
    1, :,
]
dd = DepthDamageData(data_row)
```

```
fieldnames(typeof(dd))
```

```
(:depths, :damages, :occupancy, :dmg_fn_id, :source, :description, :comment)
```

```julia
scatter(
    dd.depths,
    dd.damages;
    xlabel="Flood Depth at House",
    ylabel="Damage (%)",
    label="$(dd.description) ($(dd.source))",
    legend=:bottomright,
    size=(700, 500),
)
```
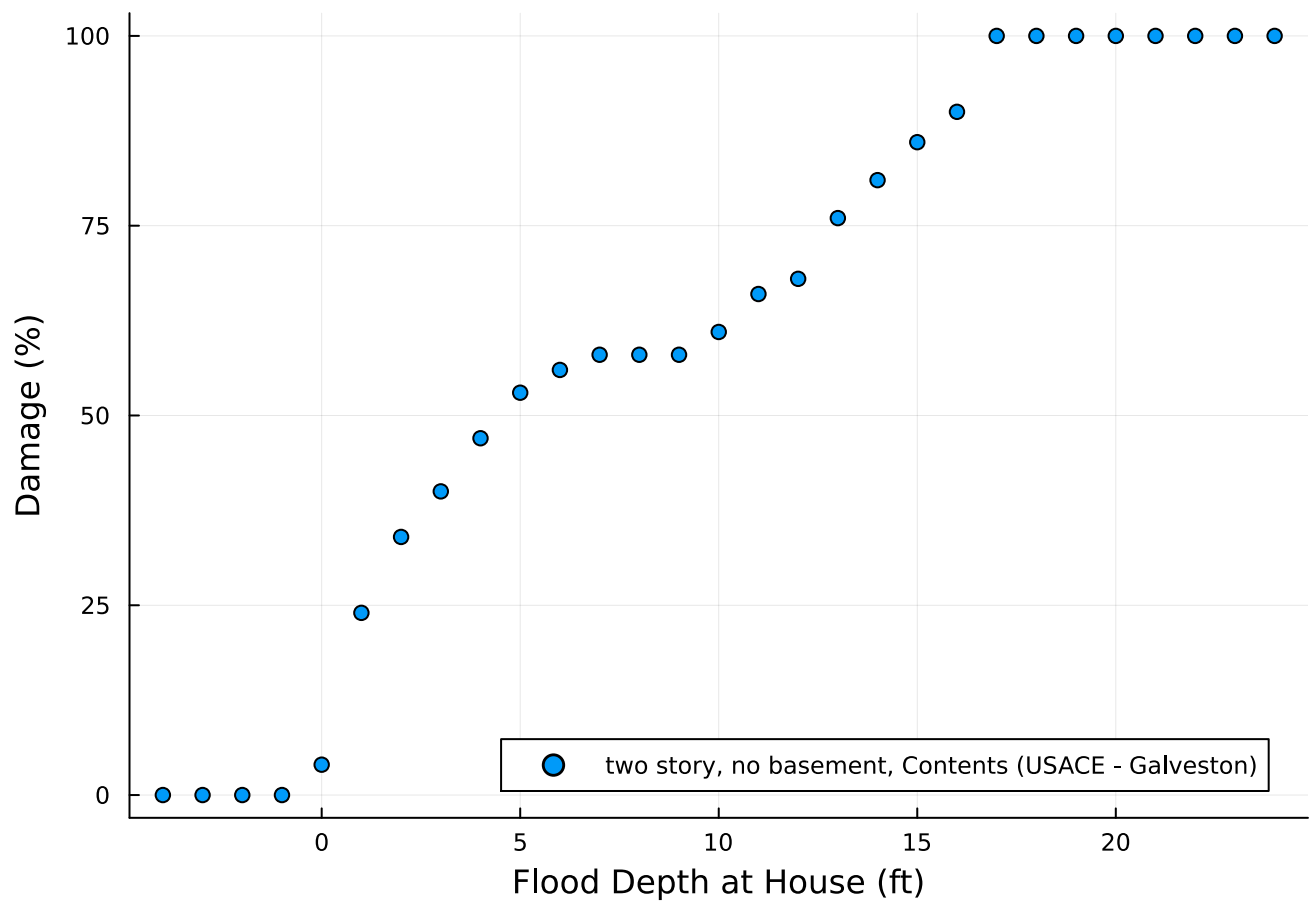
```julia
function get_depth_damage_function(
    depth_train::Vector{<:T}, dmg_train::Vector{<:AbstractFloat}
) where {T<:Unitful.Length}

    # interpolate
    depth_ft = ustrip.(u"ft", depth_train)
    interp_fn = Interpolations.LinearInterpolation(
        depth_ft,
        dmg_train;
        extrapolation_bc=Interpolations.Flat(),
    )

    damage_fn = function (depth::T2) where {T2<:Unitful.Length}
        return interp_fn(ustrip.(u"ft", depth))
    end
    return damage_fn
end

damage_fn = get_depth_damage_function(dd.depths, dd.damages)
```
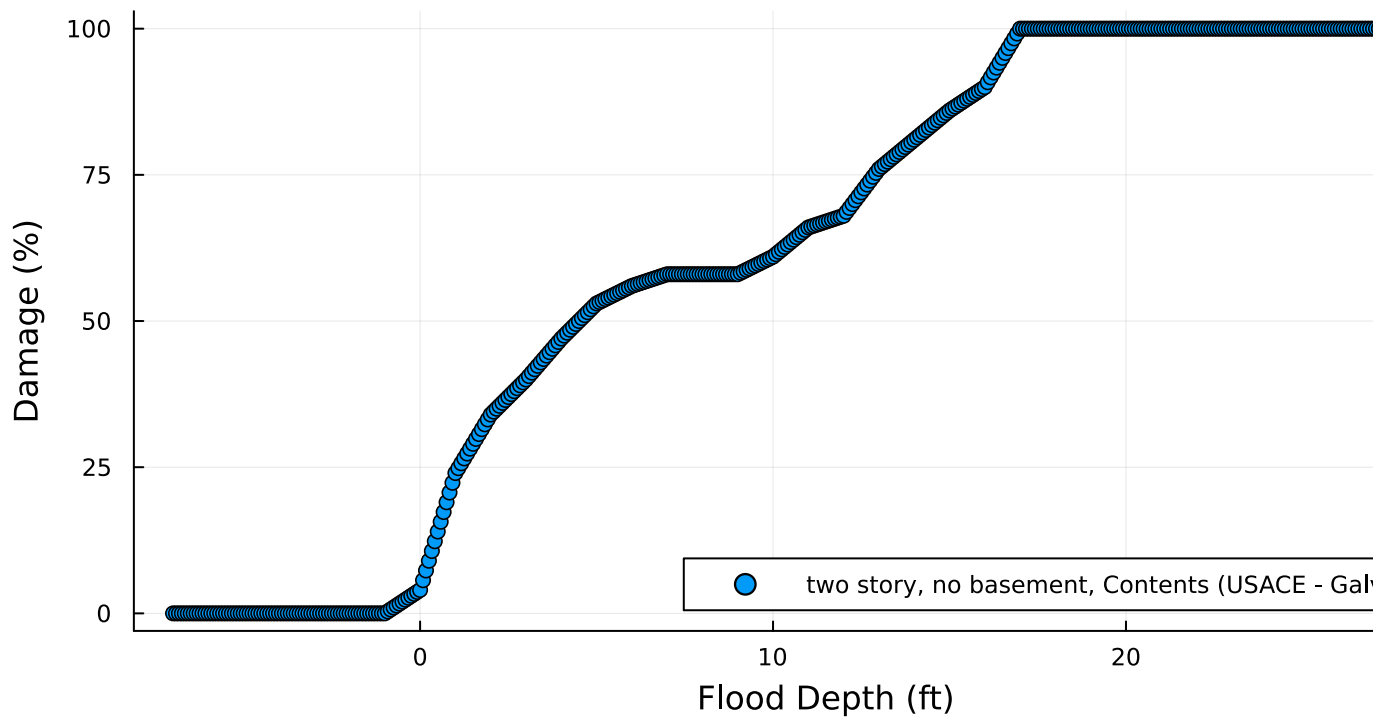
```
#53 (generic function with 1 method)
```

```julia
p = let
    depths = uconvert.(u"ft", (-7.0u"ft"):(1.0u"inch"):(30.0u"ft"))
    damages = damage_fn.(depths)
    scatter(
        depths,
        damages;
        xlabel="Flood Depth",
        ylabel="Damage (%)",
        label="$(dd.description) ($(dd.source))",
        legend=:bottomright,
        size=(800, 400),
        linewidth=2,
    )
end
p
```

## Expected annual damages

```
gauge_dist = GeneralizedExtremeValue(5, 1.5, 0.1)

# adjust for elevation
offset = 3.84 # house is 3.84 feet above gauge
house_dist = GeneralizedExtremeValue(gauge_dist.μ - offset, gauge_dist.σ,
gauge_dist.ξ)

# get 1 million samples
n_samps = rand(house_dist, 1000000)
n_samps *=1u"ft"
# samps_ft = ustrip.(u"ft", n_samps)
typeof(n_samps)
# Apply Depth Damage Fn to all samples


damages = damage_fn.(n_samps)

avg_dmg = mean(damages)

print(avg_dmg)
```

```
29.916007984597826
```

## Discussion

Chosen Depth-Damage Fn: Galveston,"two story, no basement,"

This is appropriate because the selected site has the listed characteristics and is in Galveston.

Average Damage: The Average damage being 29.9% means that this property is projected to receive 29.9% damage in any given year with the given pdf for hazard (water level).