# Initial Abstractions and Rational Runoff Coefficients

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# Initial Abstraction

- One of the fundamental concepts in the conversion of rainfall into runoff.
- A threshold value of rainfall that must occur before runoff is seen from a watershed.
- Its magnitude is not often discussed openly; Texas research indicates that it is of significant magnitude.

# Runoff Coefficient

- Fraction of rainfall that becomes runoff; whether runoff is considered a rate, depth, or volume depends on the context.
- Ratio of runoff to rainfall.
- Maps rainfall directly to runoff.
- Implies that rainfall of probability X results in runoff of probability X.

# Are these two concepts compatible?

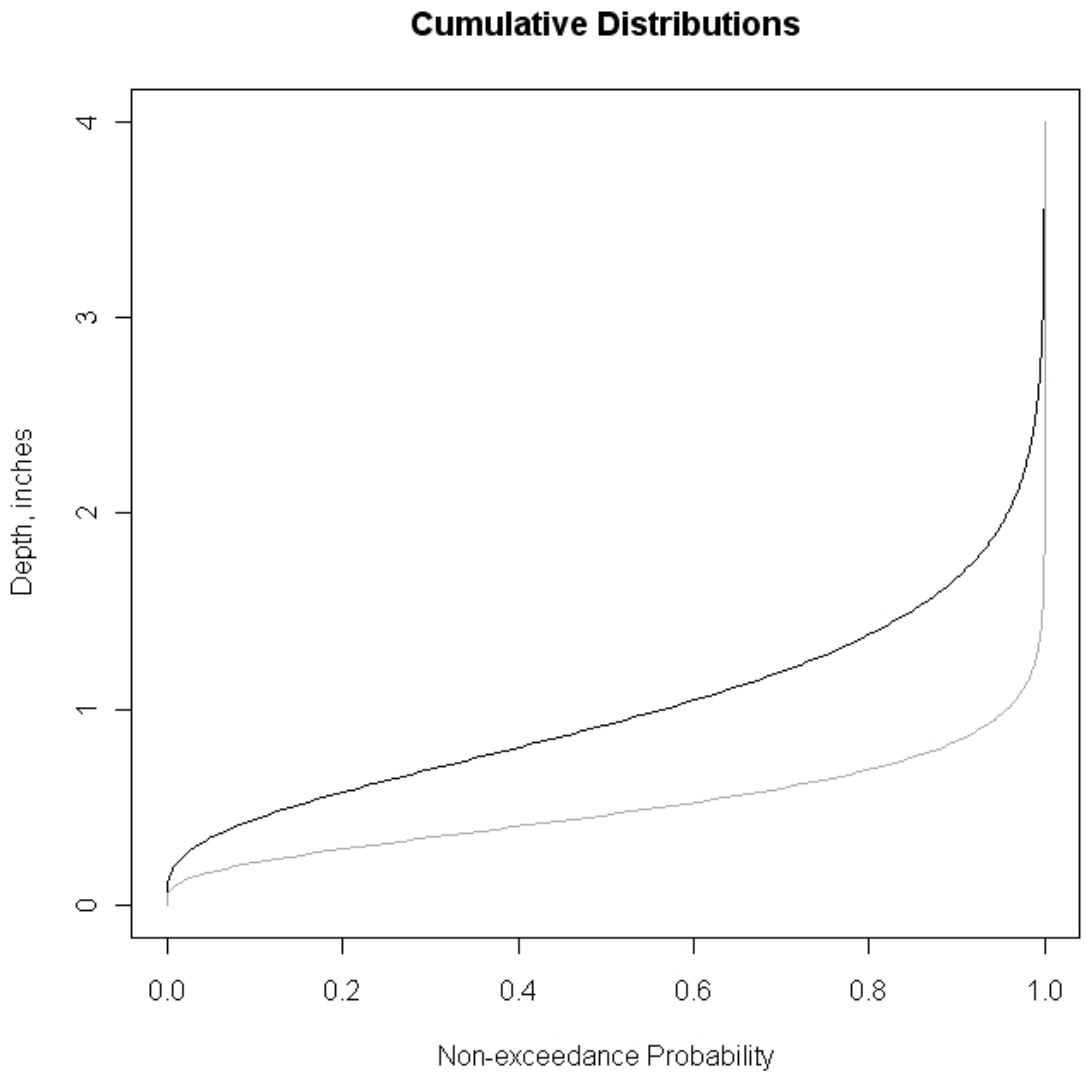
# Thought experiment

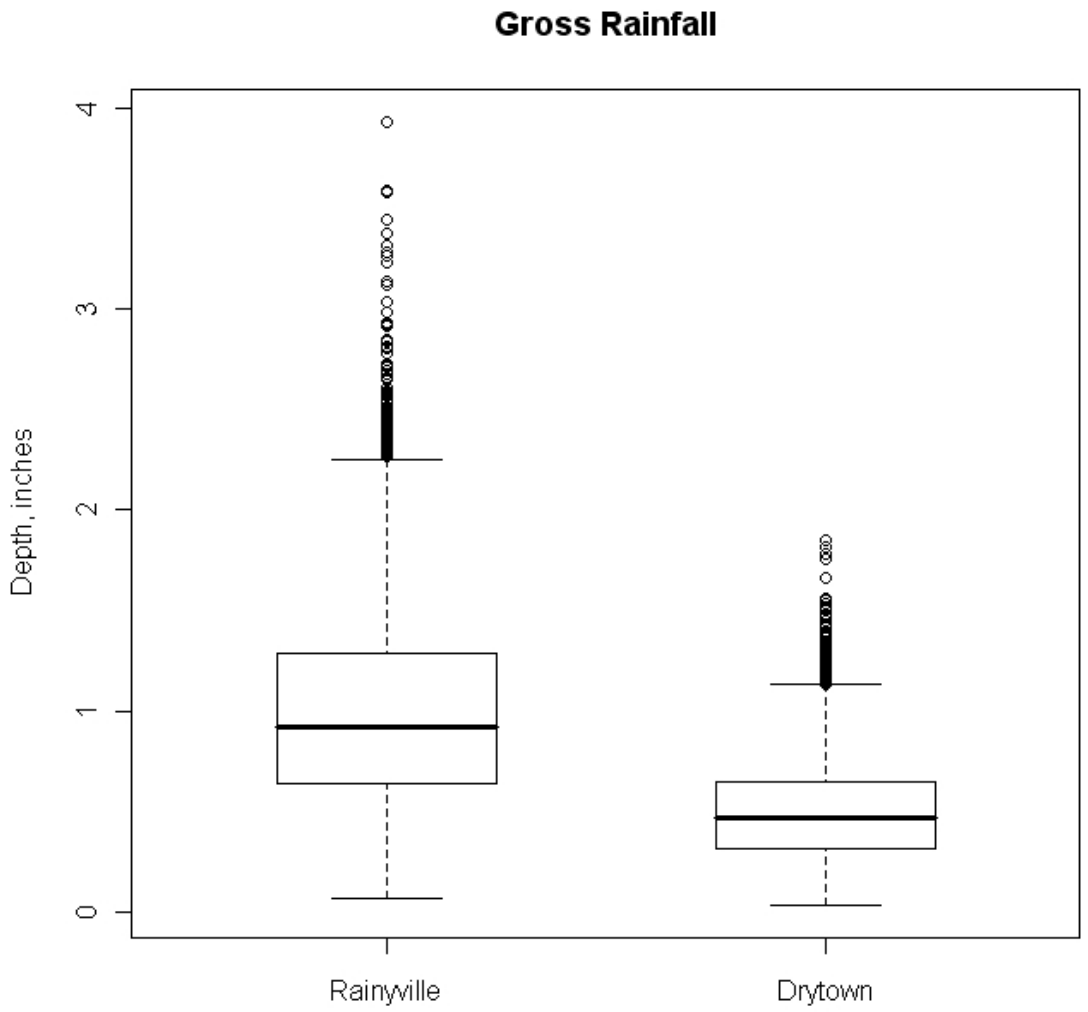
- Assume that the initial abstraction is invariant with location.
- Assume that there are two locations that differ only in the expectation of rainfall
- Simulate some rainfall events and account only for the initial abstraction.
- Compare ratios of rainfall to runoff

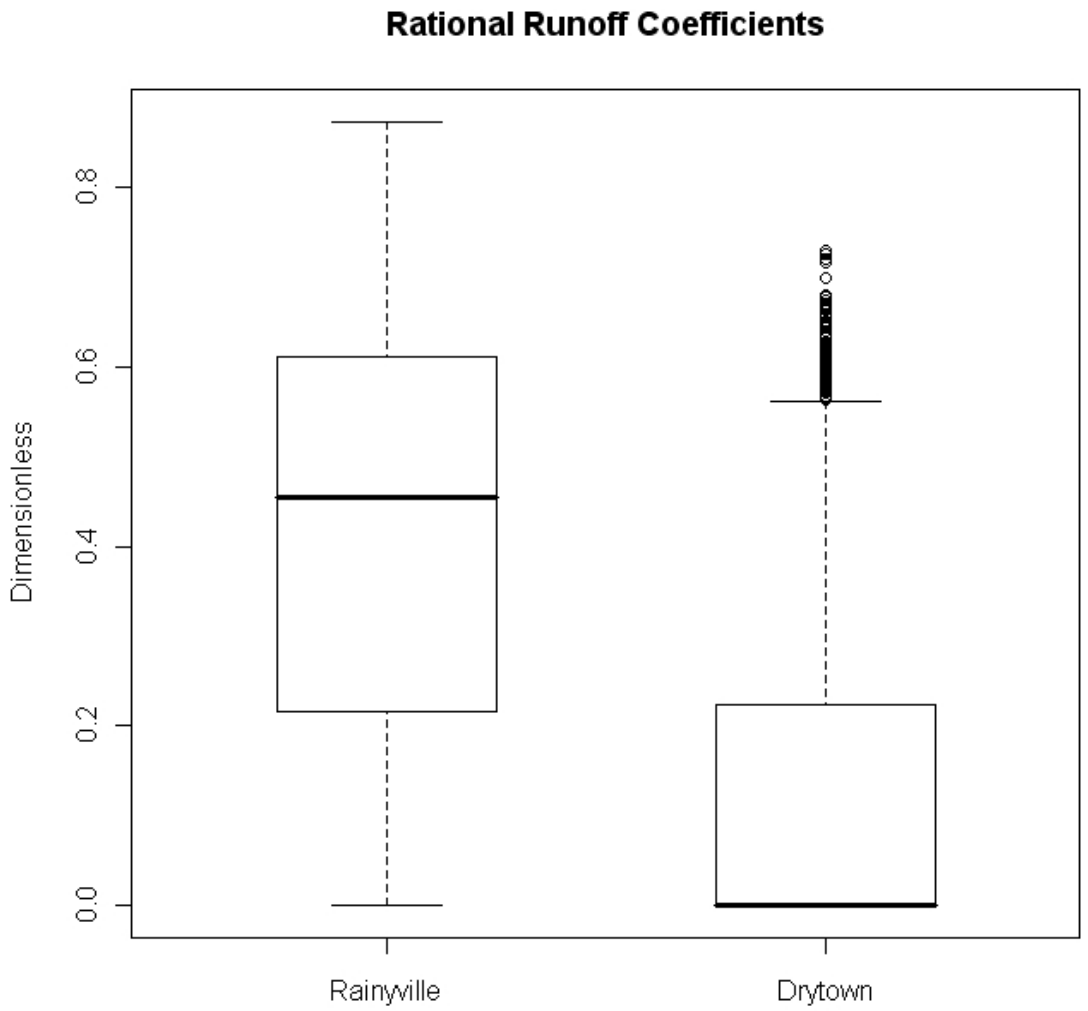
# Rainyville vs. Drytown

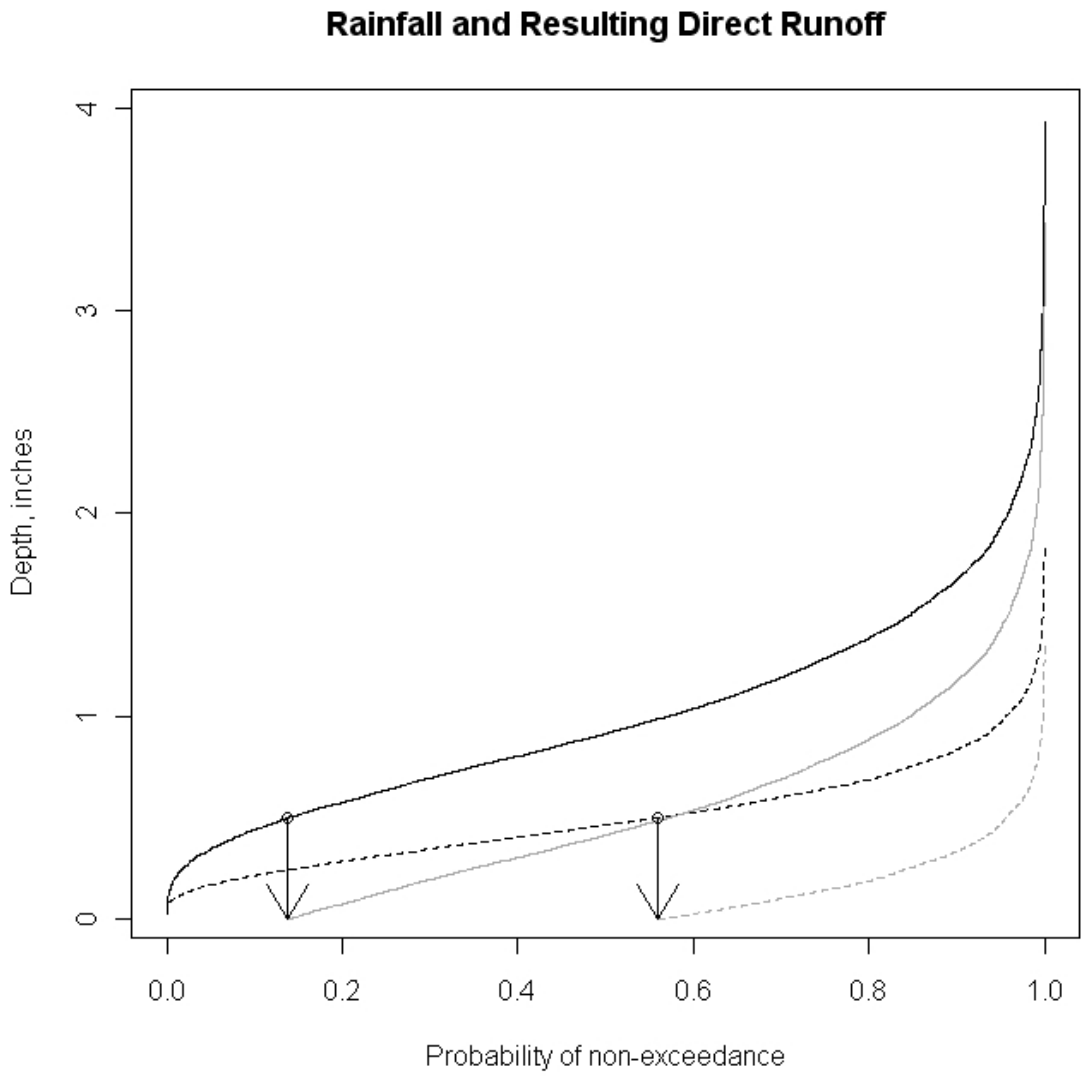
- Constructed mean event depth 1”
- Ia=0.5 inches
- Gamma distributed
- 5200 events
- 52 inches per year

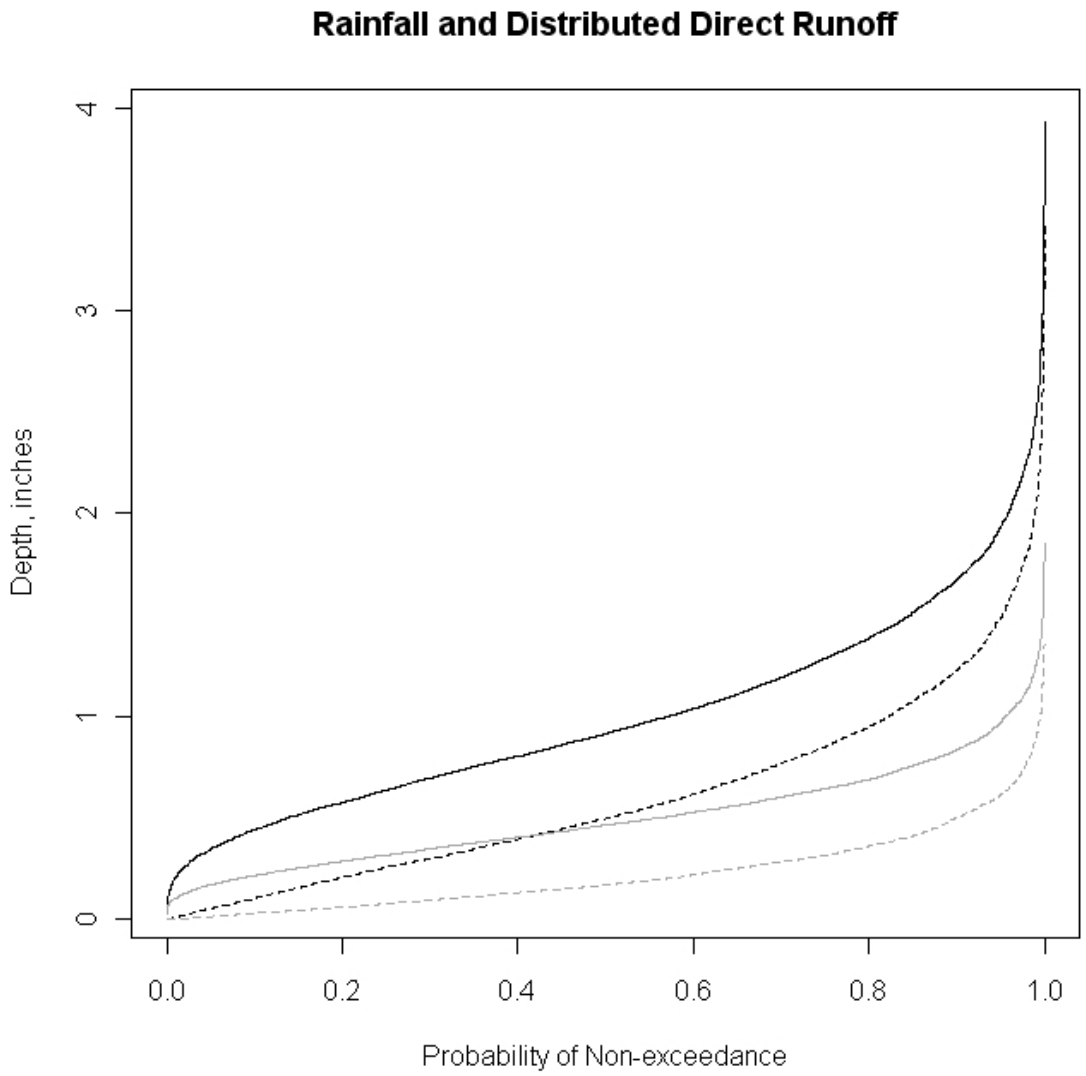
- Constructed mean event depth 0.5 inches
- Ia=0.5 inches
- Gamma distributed
- 5200 events
- 26 inches per year


Cumulative Distributions
Depth, inches
0
1
2
3
4
0.0
0.2
0.4
0.6
0.8
1.0
Non-exceedance Probability


Gross Rainfall
Depth, inches
0
1
2
3
4
Rainyville
Drytown


Rational Runoff Coefficients
Dimensionless
0.0
0.2
0.4
0.6
0.8
Rainyville
Drytown


Rainfall and Resulting Direct Runoff
Depth, inches
0
1
2
3
4
0.0
0.2
0.4
0.6
0.8
1.0
Probability of non-exceedance


Rainfall and Distributed Direct Runoff
Depth, inches
0
1
2
3
4
0.0
0.2
0.4
0.6
0.8
1.0
Probability of Non-exceedance

# So what?

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- Mapping of rainfall to runoff should be considered climatically contextual; we shouldn't assume that a relationship developed where there is 52 inches of rainfall a year directly translates meaningfully to an area where there is 26 inches per year.

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- In arid areas in particular, data collected and analyzed should include rainfall events that produce no runoff. Techniques of censored data analysis (non-detects) appear well adapted to this problem.
- If rainfall and runoff are analyzed separately, then the X-year rainfall may not be assumed to produce the X-year runoff.

# Conclusions

- Hydrology in arid areas is NOT the same as hydrology in humid areas.
- Thought and research specific to arid area hydrology is needed, what works elsewhere may not work here.