



Book III, Chapter 4 Monte Carlo Simulation

ARR Workshop 29th November 2005

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Erwin Weinmann, Monash University



achieve > remarkable > success

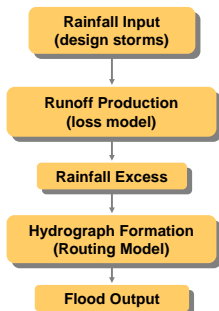


Contents

- Introduction
- Simulation process
- Stochastic sampling
 - Inverse transformation approach
 - Random number generation
 - Probability distributions
- Estimation of exceedance probabilities
 - Direct sampling
 - Stratified sampling
- Hydrological applications
- Worked examples



Flood Simulation Components





Flood Simulation Approaches

DETERMINISTIC

PROBABILISTIC

COMPREHENSIVE

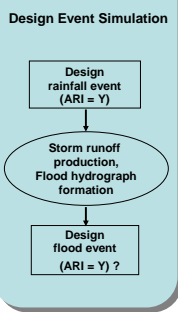


Flood Simulation Approaches

DETERMINISTIC

PROBABILISTIC

COMPREHENSIVE



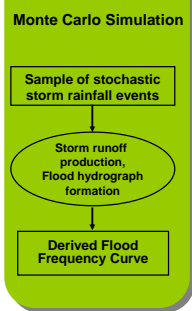
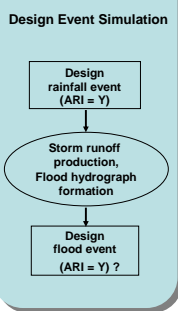


Flood Simulation Approaches

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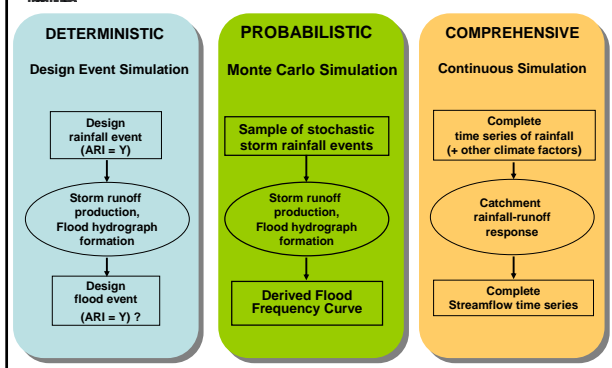
PROBABILISTIC

COMPREHENSIVE



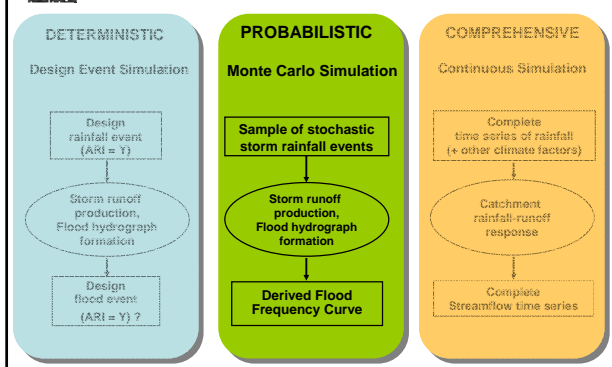


Flood Simulation Approaches





Flood Simulation Approaches



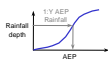


Design Event Approach

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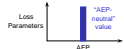
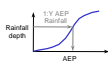
Design Event Approach



Inputs



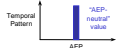
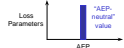
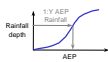
Design Event Approach



Inputs



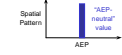
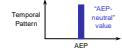
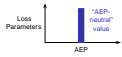
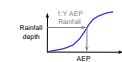
Design Event Approach



Inputs



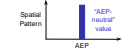
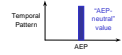
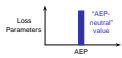
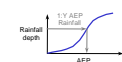
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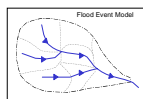
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Design Event Approach



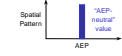
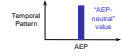
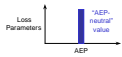
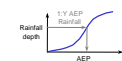
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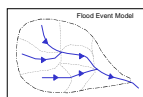
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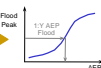
Design Event Approach



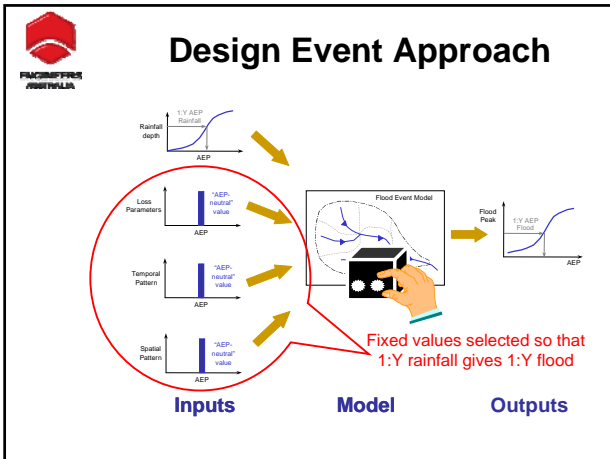
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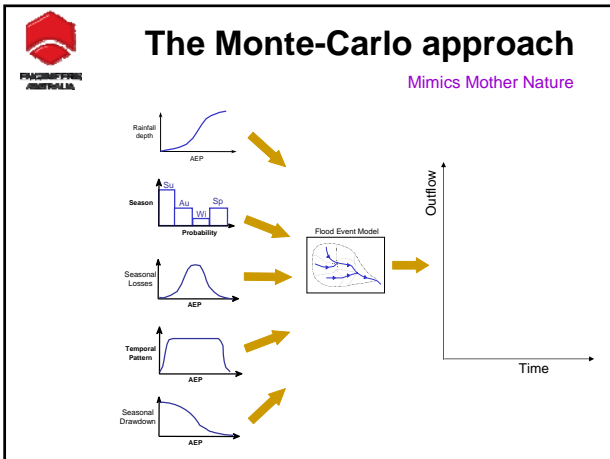


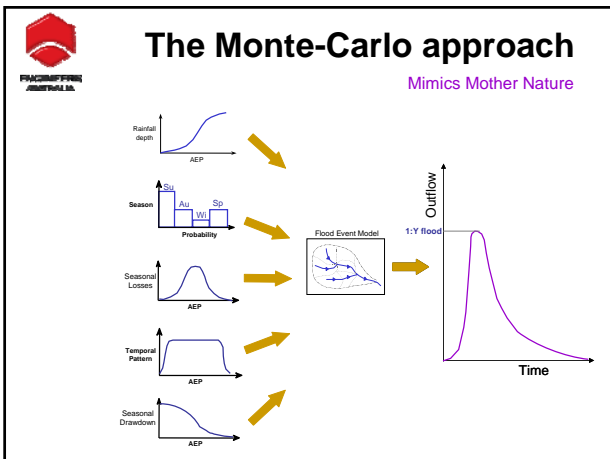
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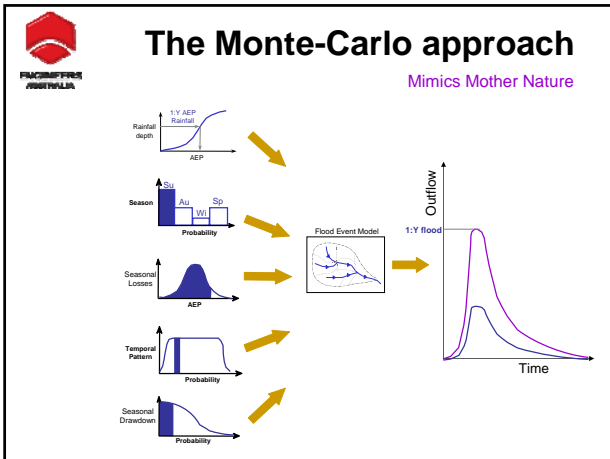


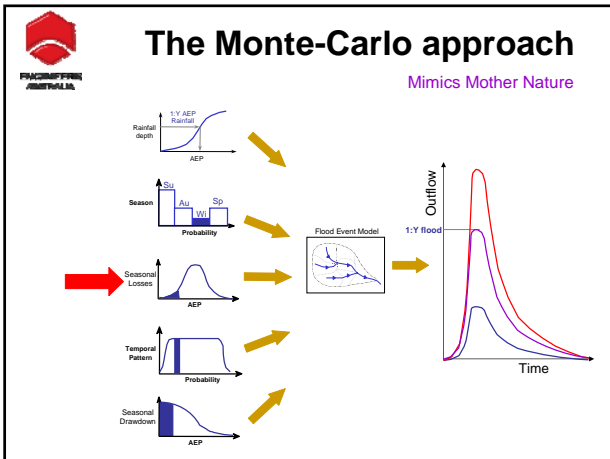
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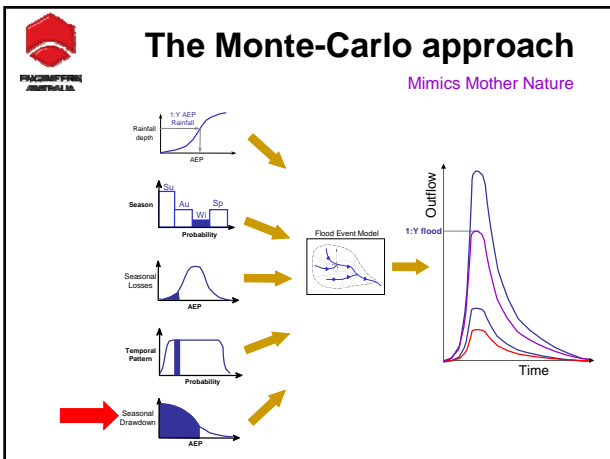


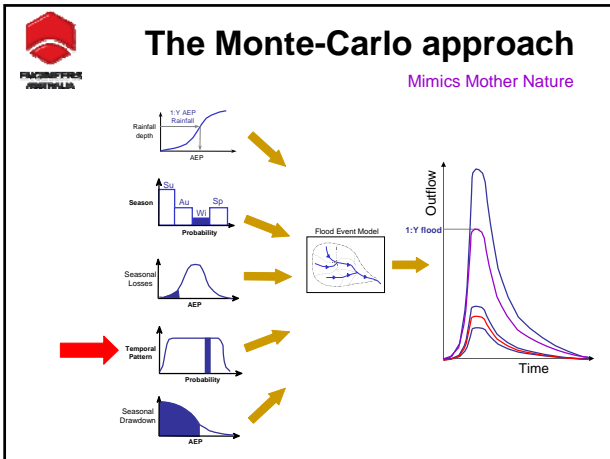


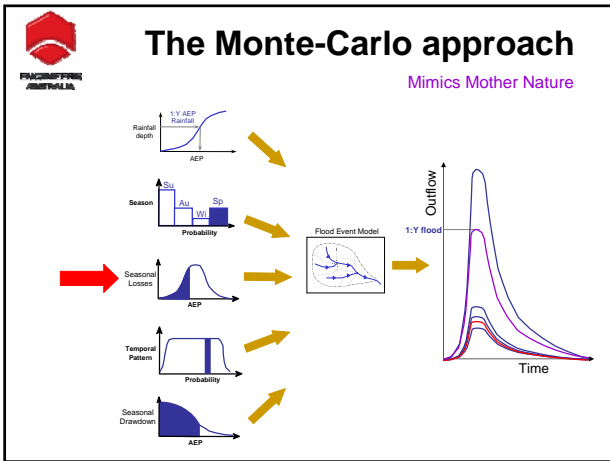


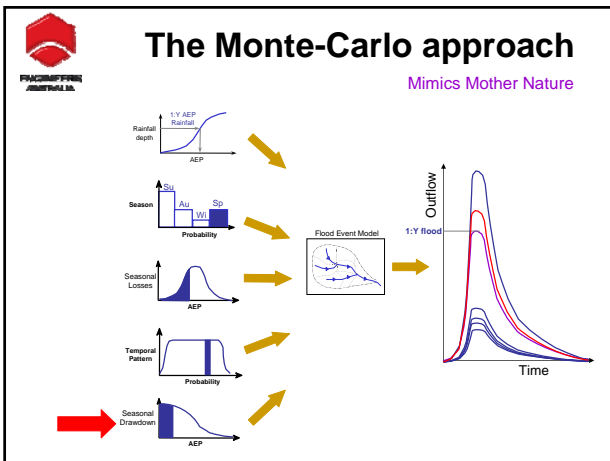


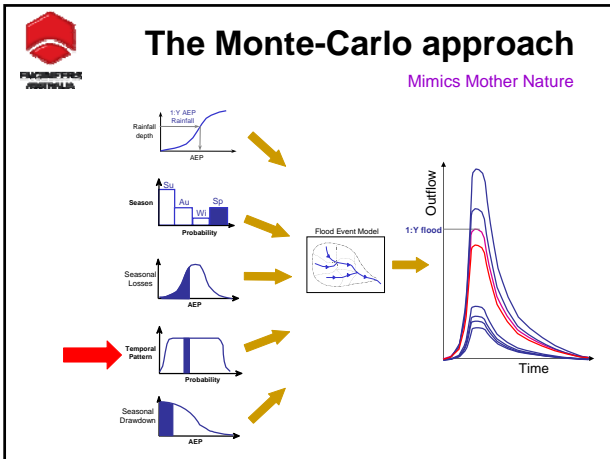


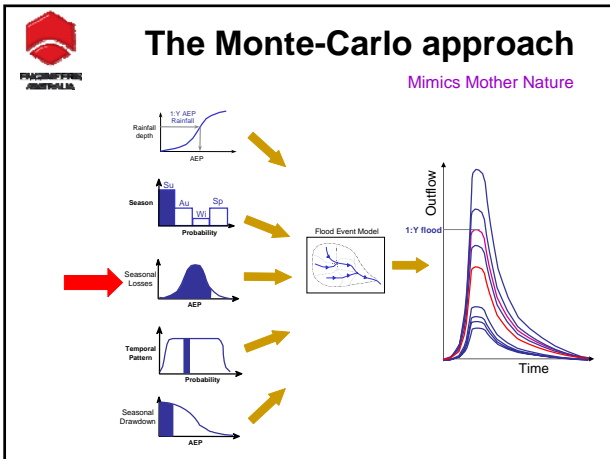


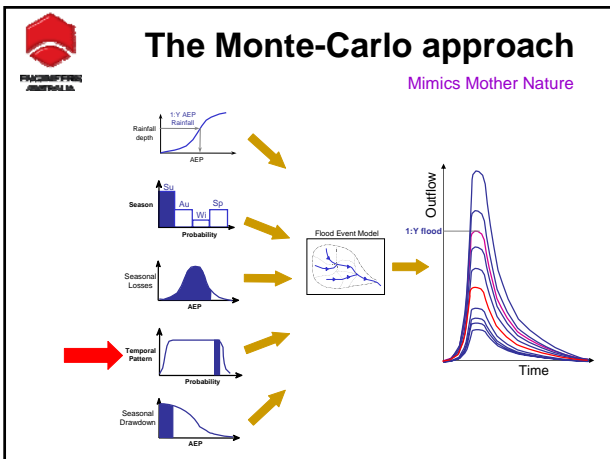


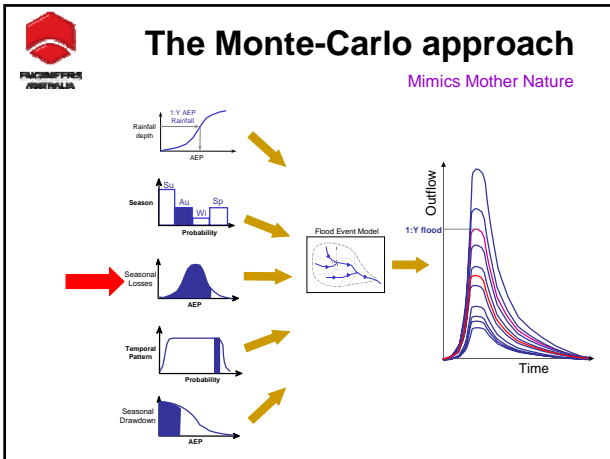


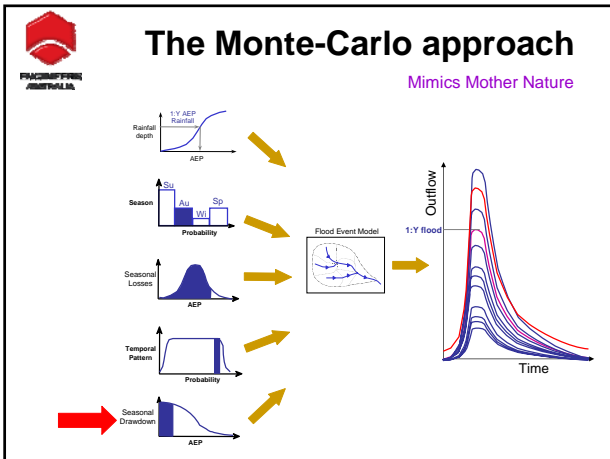


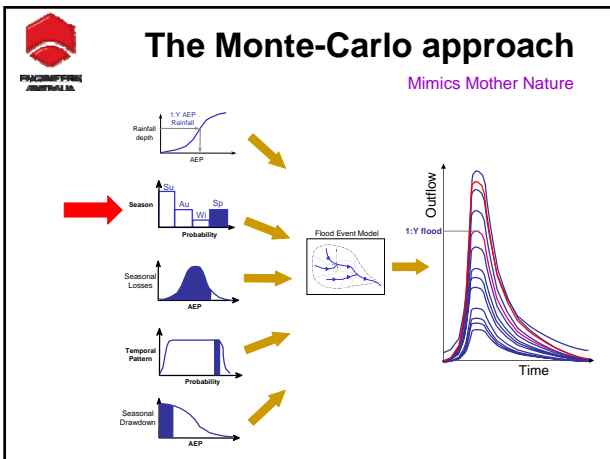


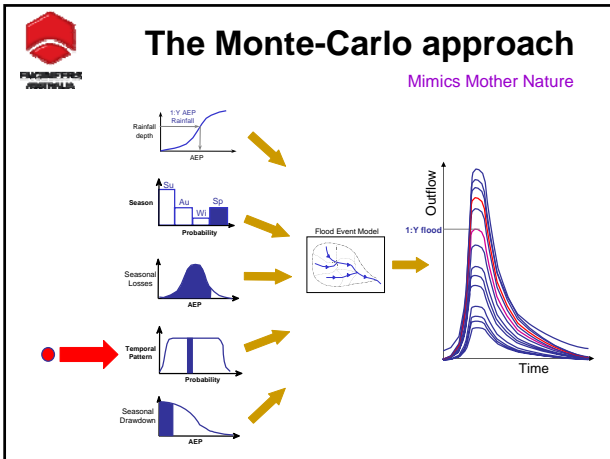


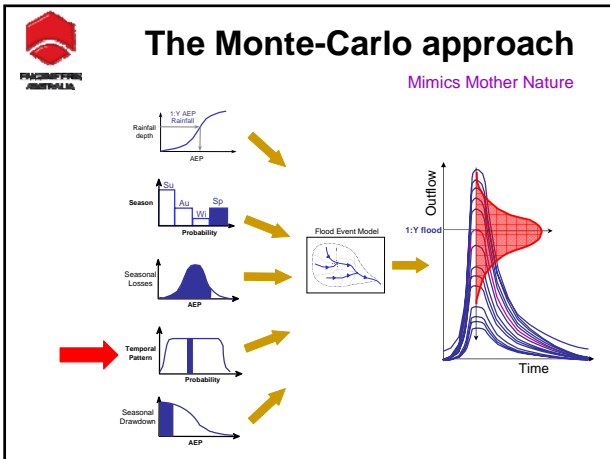


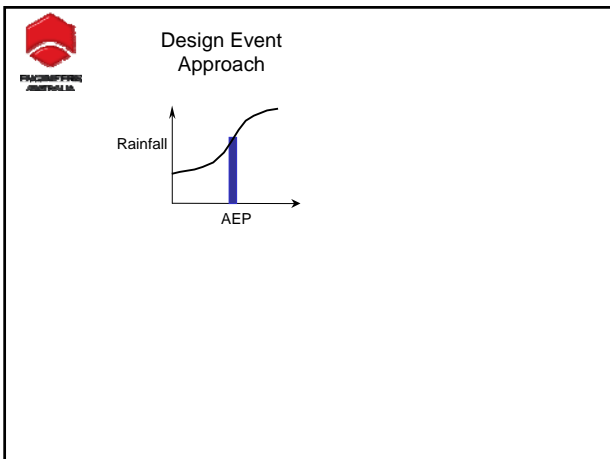


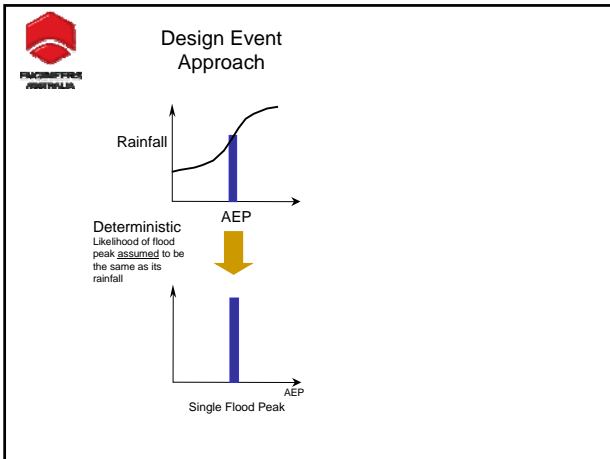


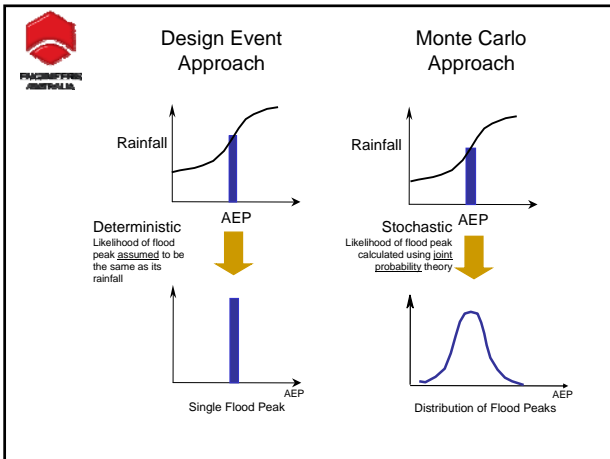


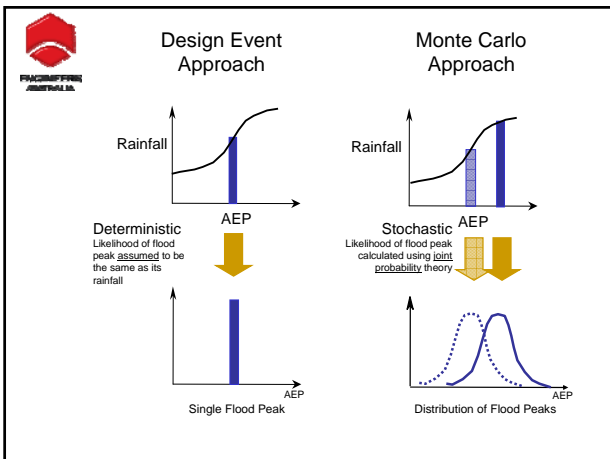














Monte-Carlo Framework



Select rainfall depth

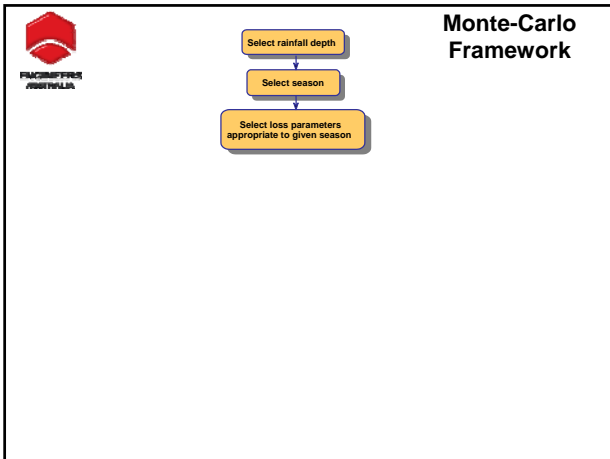
Monte-Carlo Framework

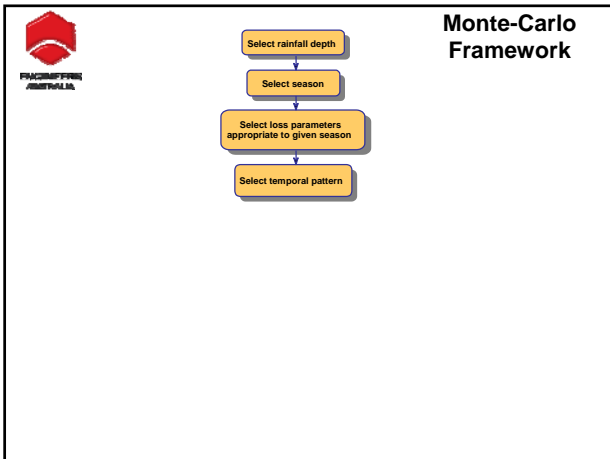


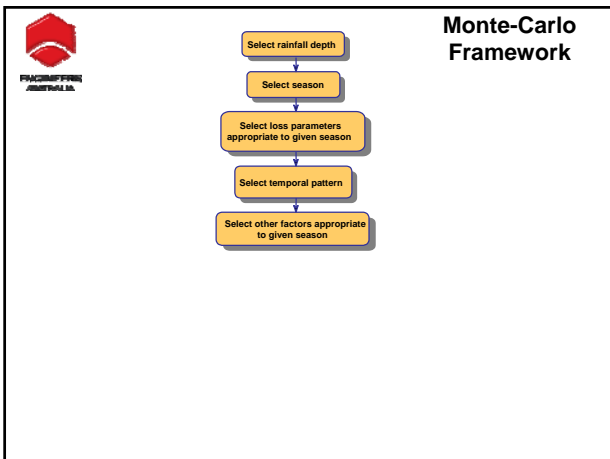
Select rainfall depth

Select season

Monte-Carlo Framework

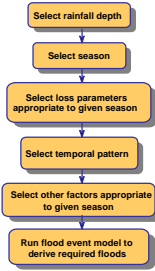






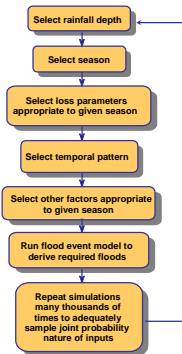


Monte-Carlo Framework



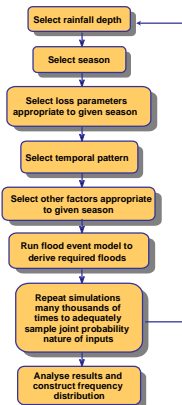


Monte-Carlo Framework





Monte-Carlo Framework





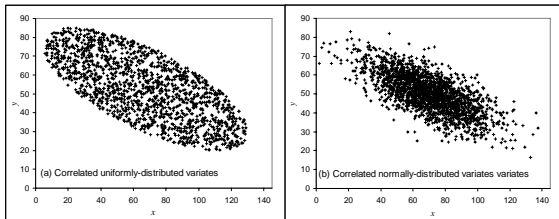
Stochastic Sampling

- Inverse transformation approach
- Random number generation
- Distributions
 - Uniform
 - Normal
 - Triangular
 - Beta
 - Empirical



Stochastic Sampling

- Generating correlated variates



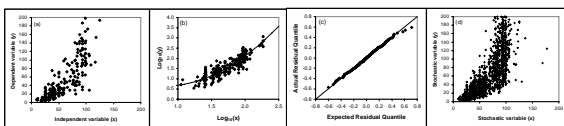
Correlated uniform

Correlated Normal



Stochastic Sampling

- Use of fitted functions



Data

Transform & fit function

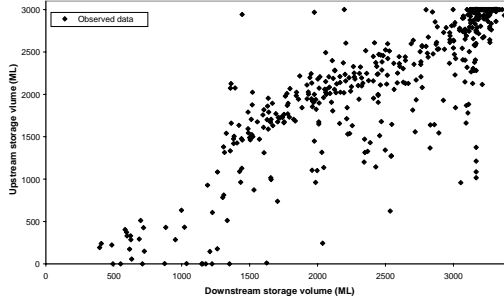
Some diagnostics

Generate



Stochastic Sampling

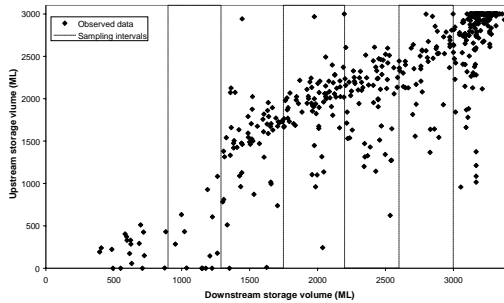
- Conditional sampling





Stochastic Sampling

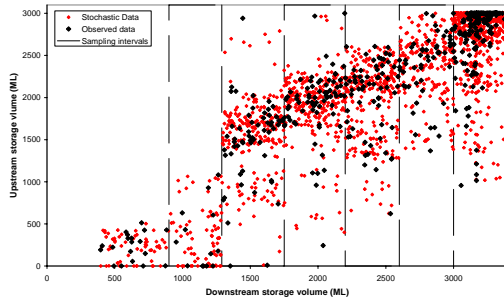
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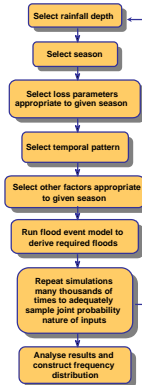
Stochastic Sampling

- Conditional sampling





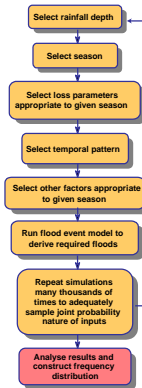
Exceedance Probabilities





Exceedance Probabilities

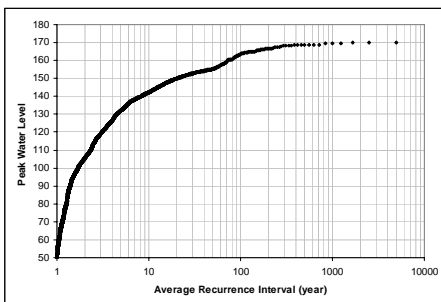
- Direct sampling





Exceedance Probabilities

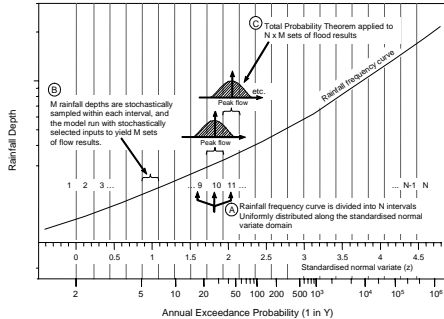
- Direct sampling





Exceedance Probabilities

- Stratified sampling





Hydrological Applications

- Temporal patterns
- Losses
- Concurrent tributary flows
- Operational factors
- Characterising uncertainty



Worked Examples

- Spreadsheet based
- Nature of guidance suited to those with:
 - No programming experience
 - Limited to advanced programming experience
- References to available source code included





Conclusions

- Monte Carlo methods avoid some major assumptions required in use of “design event” approach
- Existing design information and models used to provide “probability-neutral” estimates of design floods
- Chapter provides theory and “cookbook” guidance for implementation in spreadsheet or “batch” framework for current model-of-choice
- Draft chapter currently being polished prior to formal review
