Practical Issues in Computing Aggregate Loss Distributions

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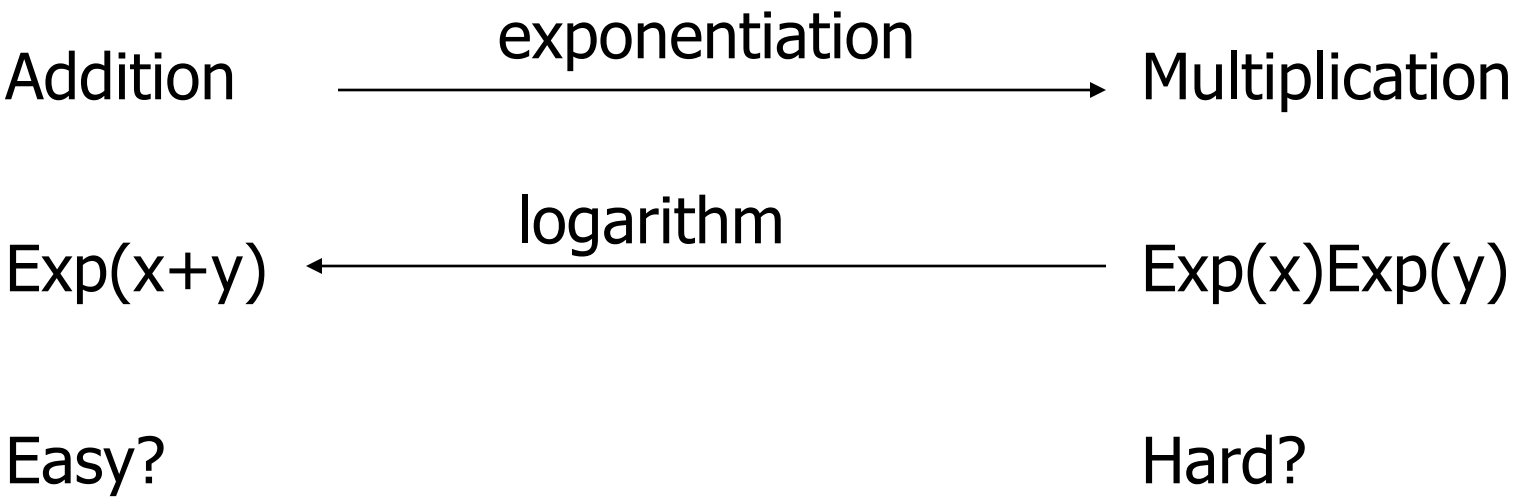
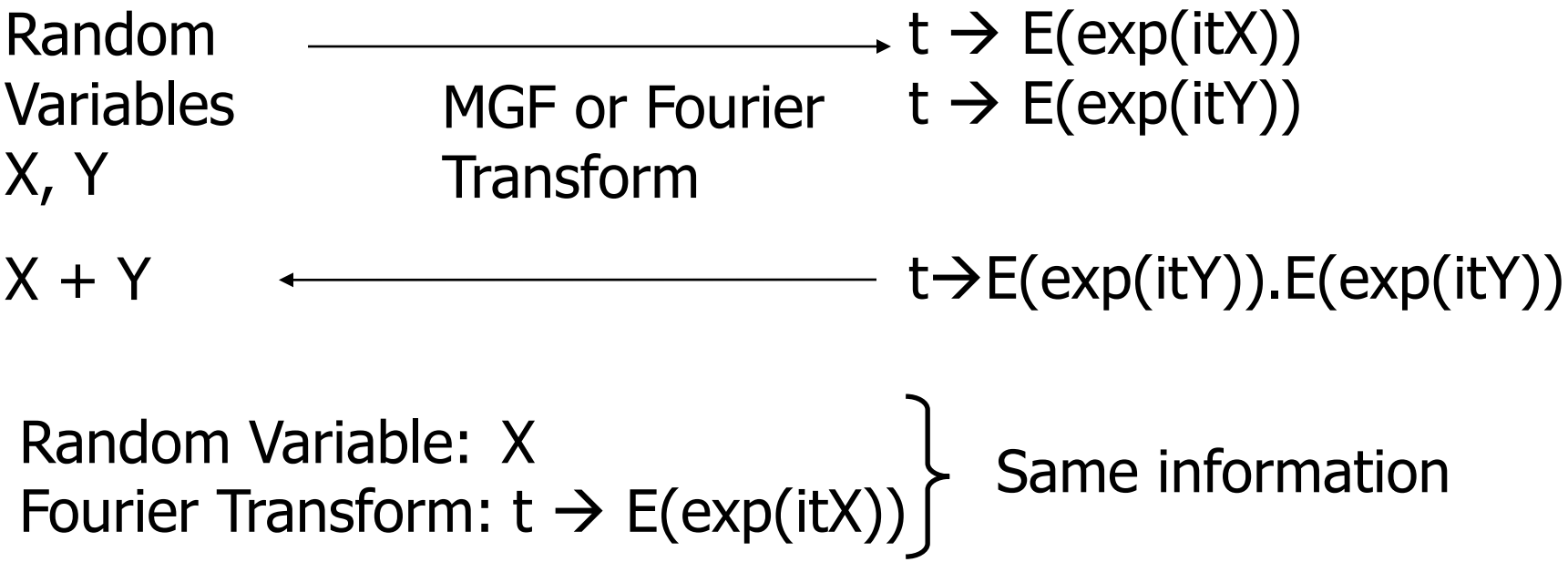
CNA Re

FFT Roadmap

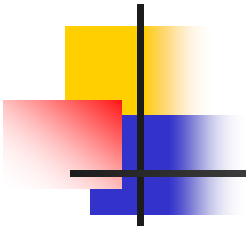

Addition
exponentiation
Multiplication
Exp(x+y)
logarithm
Exp(x)Exp(y)
Easy?
Hard?

FFT Roadmap



Random Variable: X
Fourier Transform: t → E(exp(itX))

} Same information



FFT Roadmap

- Fourier Transform is a continuous function
- Discrete Fourier Transform (DFT) is a sample of the Fourier Transform
  - Contains approximately the same information
  - Two-way street, convert X to DFT(X) to X
  - Computes sums (convolutions)
- DFT is just matrix multiplication DFT(X)= **M** X
- Fast Fourier Transform is a very, very fast way of computing DFT(X)
- Available in MALT, Excel, Matlab, SAS, C/C++
  - Black-box or learn to program

FFT Roadmap

Random variables **X**, **Y** (*n* x 1 vectors of real numbers, sum=1)

→

DFT(**X**), DFT(**Y**) (*n* x 1 vectors of complex numbers, computed very quickly using FFT)

↓

DFT(**X**) x DFT(**Y**) (component-by-component product)

←

Inverse DFT = distribution of **X**+**Y** (!)

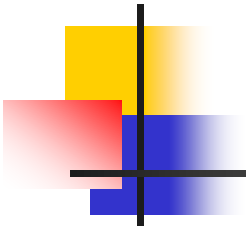
Step-by-Step Convolution Calculation

Distributions

n	X	Y	X+Y
0	0.2	0	0
1	0.2	1	0.2
2	0.2	0	0.2
3	0.2	0	0.2
4	0.2	0	0.2
5	0	0	0.2
6	0	0	0
7	0	0	0

FFTs

n	Re(FTX)	Im(FTX)	Re(FTY)	Im(FTY)	Re(FTX+Y)	Im(FTX+Y)
0	1.0000	0.0000	1.0000	0.0000	1.0000	0.0000
1	0.0000	-0.4828	0.7071	-0.7071	-0.3414	-0.3414
2	0.2000	0.0000	0.0000	-1.0000	0.0000	-0.2000
3	0.0000	-0.0828	-0.7071	-0.7071	-0.0586	0.0586
4	0.2000	0.0000	-1.0000	0.0000	-0.2000	0.0000
3	0.0000	0.0828	-0.7071	0.7071	-0.0586	-0.0586
2	0.2000	0.0000	0.0000	1.0000	0.0000	0.2000
1	0.0000	0.4828	0.7071	0.7071	-0.3414	0.3414

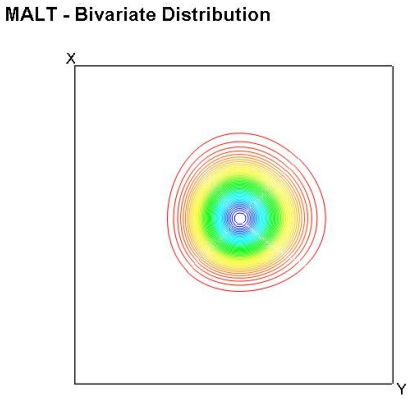


MALT Site

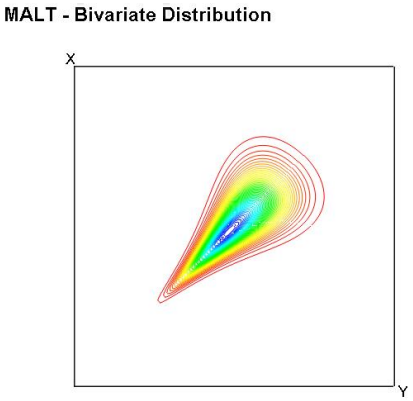
- http://www.mynl.com/MALT/home.html
- Written in response to COOS Call Program, 2000-01
- Windows 2000/NT, IE 5 required
- Download and install COM objects required
  - Can script or use in Excel/VBA

Warning to ERM Practice

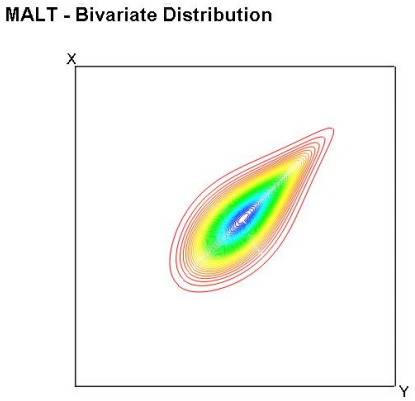
- A correlation matrix is not enough to describe the correlations at the tails



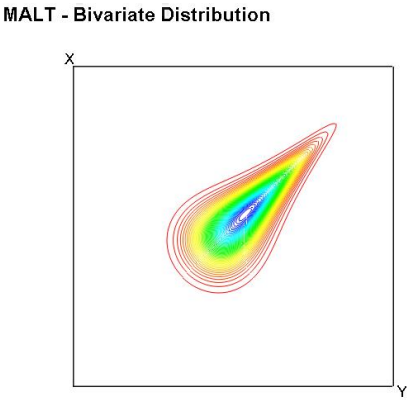
Independent



Clayton



Gumbel



Venter HRT