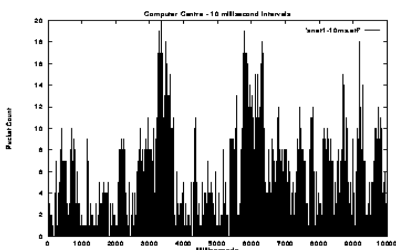
Self Similarity
and
Packet Traffic

- **Work done by Ross Alexander, Nevil Brownlee and Ilze Ziedins at the University of Auckland**
- **Time-series observation of Ethernet traffic**
- **Simulation of self-similar traffic**

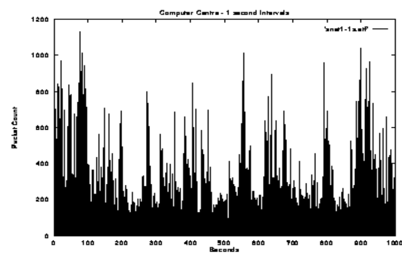
Observation of Ethernet Traffic

- **Arrival time and packet size collected and written to a disk file**
- **Data collected on a 486 PC with assembler timer routine giving 1 ms time resolution**
- **Data collected for four different subnets, sample sizes from 400k (14 minutes) to 800k (94 minutes)**

Sample Time series, 10 ms intervals



Sample Time series, 1 s intervals



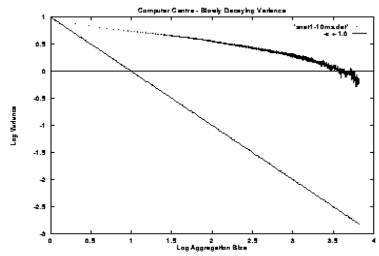
Self Similarity

- **Time series plots look similar regardless of time scale (preceding two plots are from the same data)**
- **Aggregating data *doesn't* smooth out variations**
- **This means that you will see a peak of any size - if you only wait long enough**

Decaying Variance

- **Given a sequence of measured values ..**
- **Aggregate them in groups of *m* ,**
- **Compute the variance of the groups ,**
- **Plot *log(variance)* vs *log(group size)* .**
- **Processes with finite mean and variance have variance proportional to *1/m***
- **Observed traffic has variance decaying slower than *1/m***

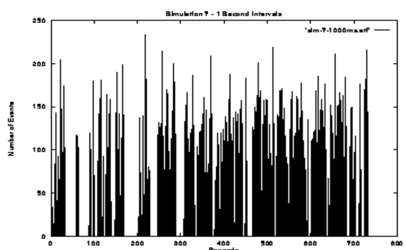
Observed Slowly Decaying Variance



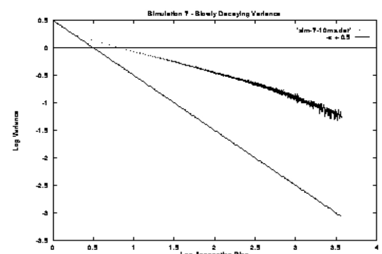
Simulation

- Processes with finite mean and variance - e.g. using Poisson distribution - show only *1/m* decay of variance
- Processes with finite mean and *infinite* variance, e.g. Pareto, Cauchy and Student t_2 show slowly decaying variance
- Student t_2 – especially 10 of them merged – seem to produce plots very like the observed ones

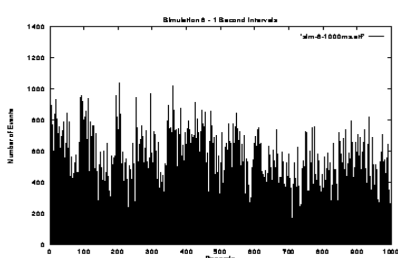
Time Series plot: single Student t_2



Decaying Variance: single Student t_2



Time Series plot: 10 merged t_2



Decaying Variance: 10 merged t_2