

# Suitability of two parameter distributions for low flows in Ireland and Wales

by

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# Outline

- Data
- Probability Plots
  - EV1
  - Lognormal
  - Descending order
- PPCC
- L-Moment Ration Plots
- Conclusions

# Abstract

- The distribution of annual minimum one day low flows has been examined for a small selection of gauging stations in Ireland and Wales. Generally the observed samples suggest positively skewed distributions. While the lognormal distribution is a reasonable descriptor the EV1 distribution is also a good candidate. This may be contrary to expectations as the EV1 is known to be a distribution of maxima, not minima.

# Source Data

- 28 series of annual minimum 1 day flows from Ireland, with
  - record lengths varying from 28 to 47 years
  - catchment areas varying from 106 to 1943 km<sup>2</sup>
- 12 series of annual minimum 1 day flows from Wales, with
  - record lengths varying from 32 to 45 years
  - catchment areas varying from 43 to 893 km<sup>2</sup>

# Seasonal Distribution of Low Flows

- While low flows are expected to occur in August or September the annual minimum flow in Ireland can occur over a surprisingly wide range of times throughout the year – even in winter. Catchments with impermeable soils are most likely to show such a wide range of season.
- This is because any period of 3 to 5 weeks of below average rain can produce low flows. Such periods can occur in Spring as well as in Summer or Autumn.

# Data Skewness

- Skewness can provide a clue as to the required form of distribution.
- Annual minimum 1 day low flow series have positive skewness, with average Hazen corrected values of
  - 1.30 for 28 Irish stations
  - 0.79 for 12 Welsh stations
- It should be noted of course that sample skewness has large standard error

## 2 Parameter Distributions

- The EV1 and LN2 distributions have been tested initially for their suitability.
- EV1 has skewness of 1.14, somewhat similar to the average value among Irish data and somewhat larger than the average among Welsh data
- LN2 has a variable skewness and can usually describe fairly well data that are mildly positively skewed

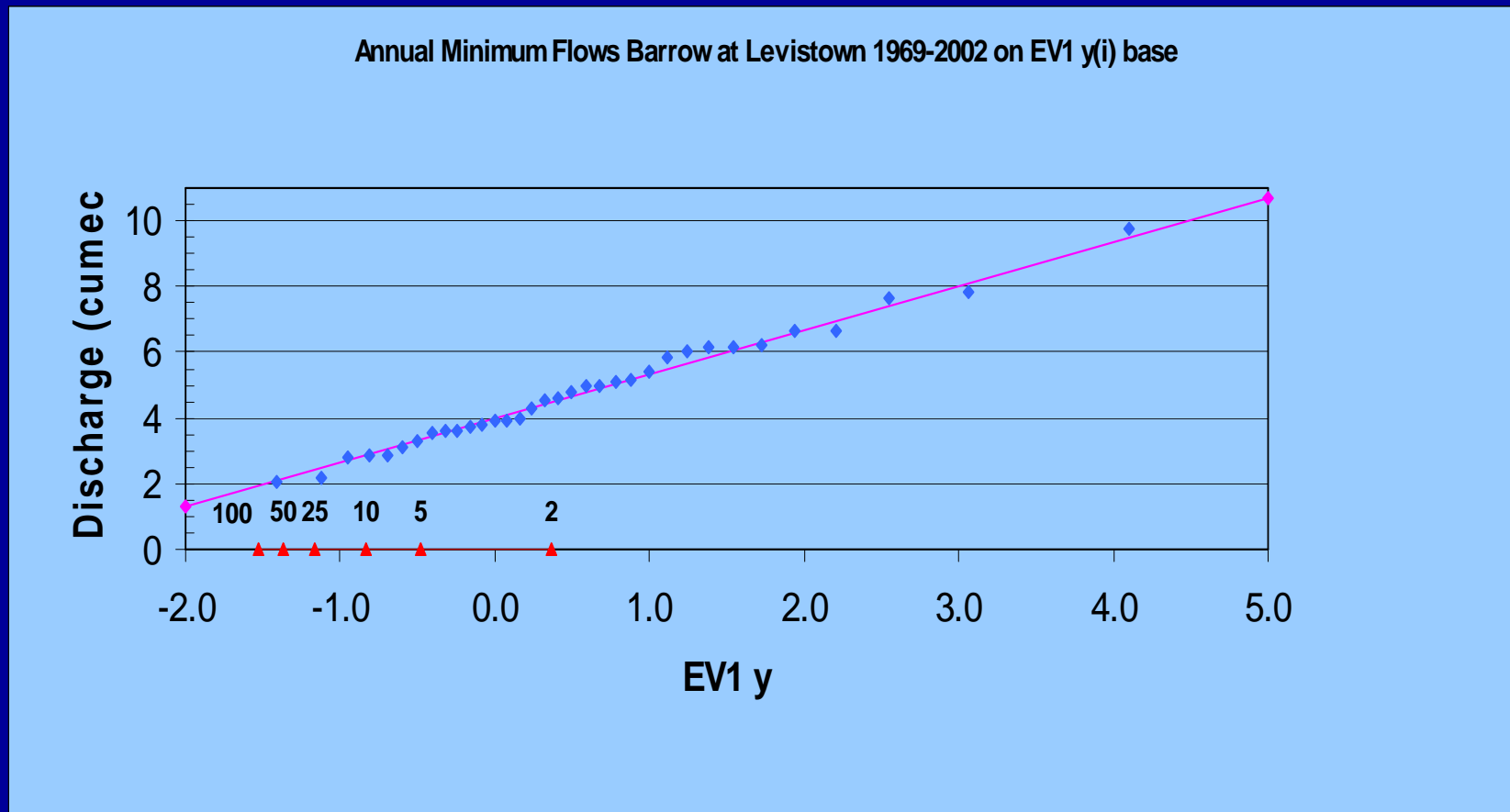
# Basis of Assessment

- Suitability is assessed on the basis of
  - Visual assessment on Probability Plots
  - Probability Plot Correlation Coefficient
  - L-Kurtosis versus L-Skewness plots

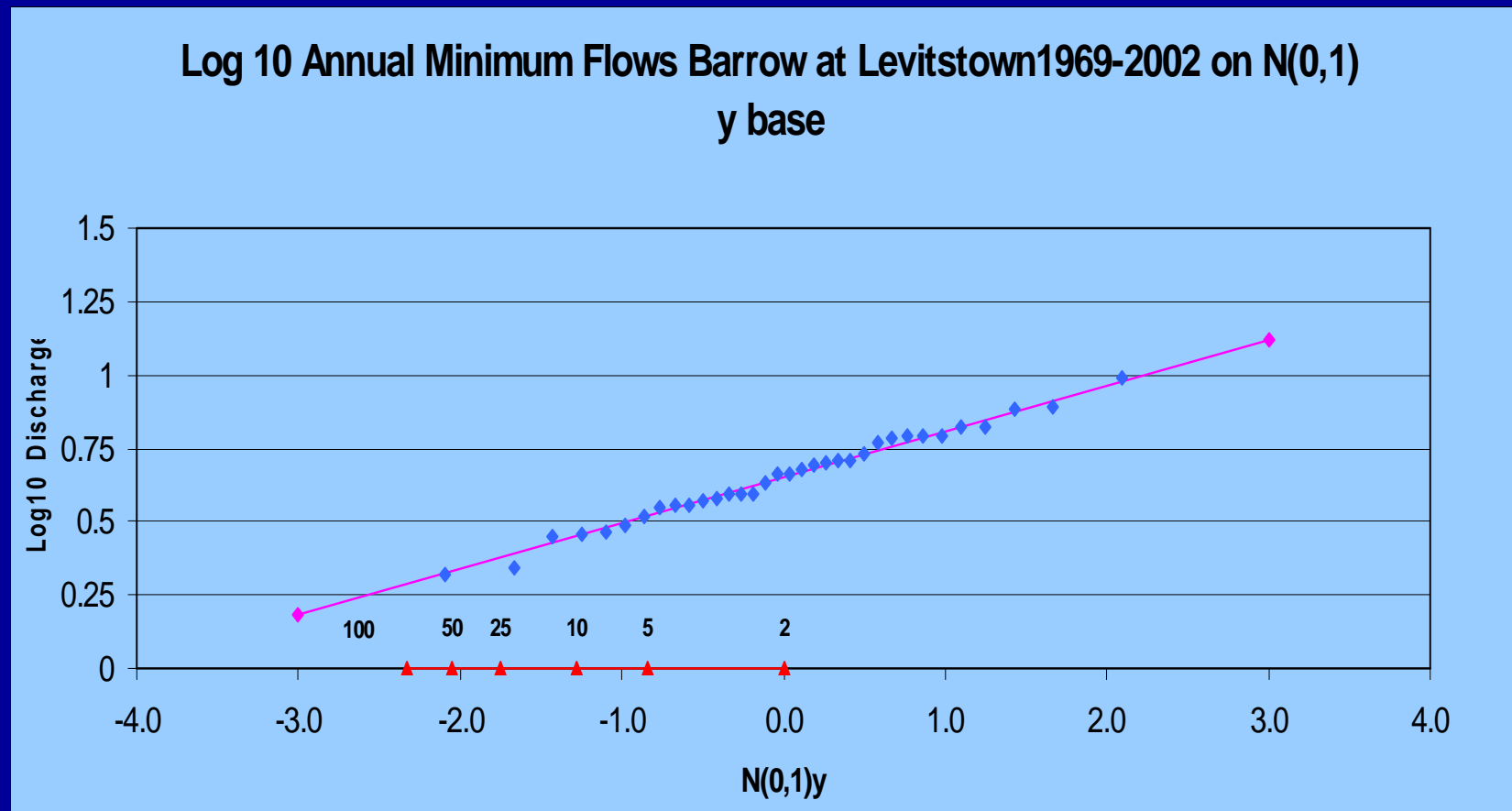
# Probability Plots

- Data from 23 out of 28 Irish stations showed remarkably good straight line patterns on EV1 plots
- Data from 5 of the stations would be best described by a curve rather than a straight line, i.e. not EV1. Plots of censored data show improvement
- All of the 12 Welsh stations showed good straight line patterns on EV1 plots

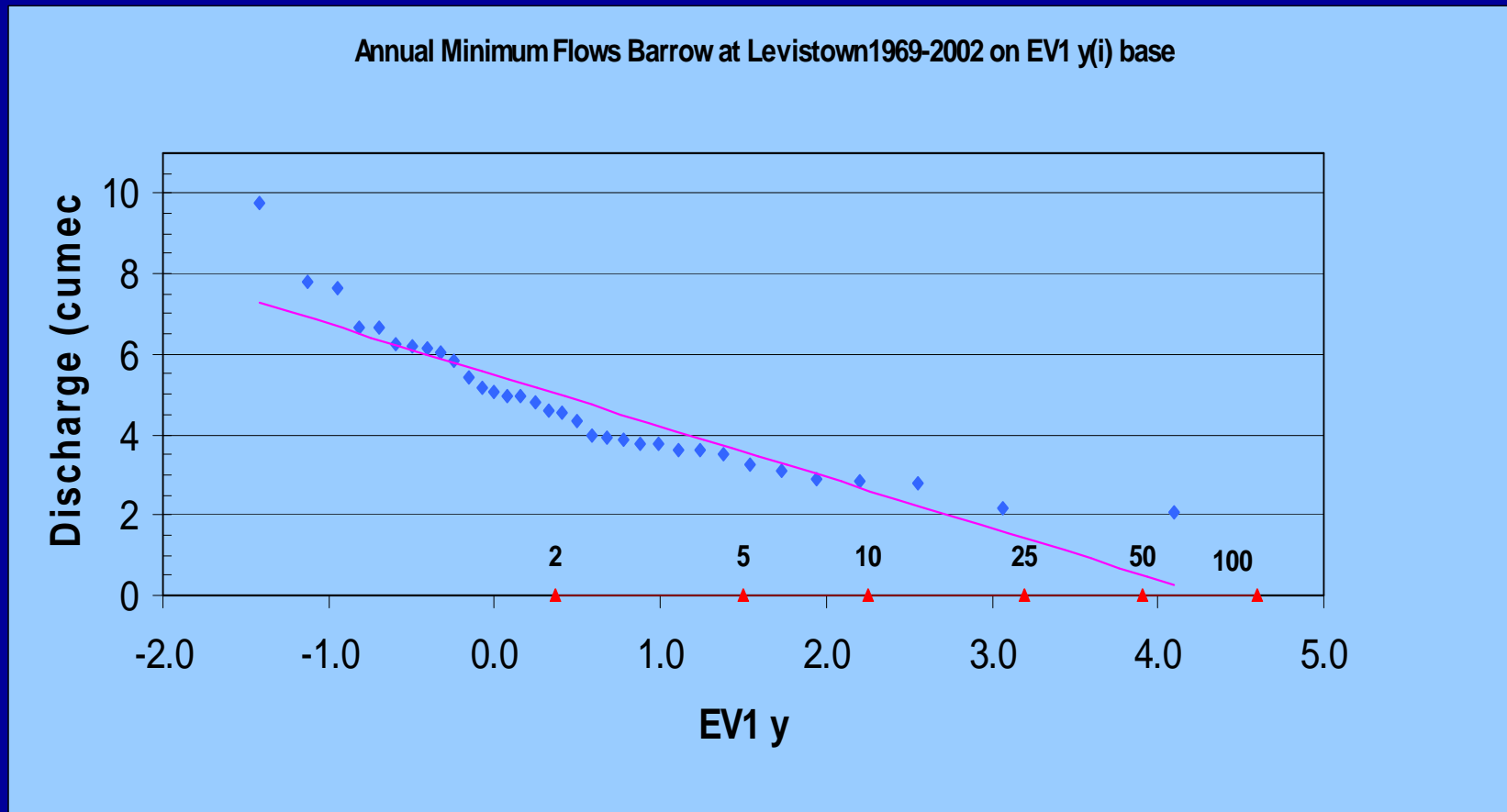
# Irish data – Good EV1 fit



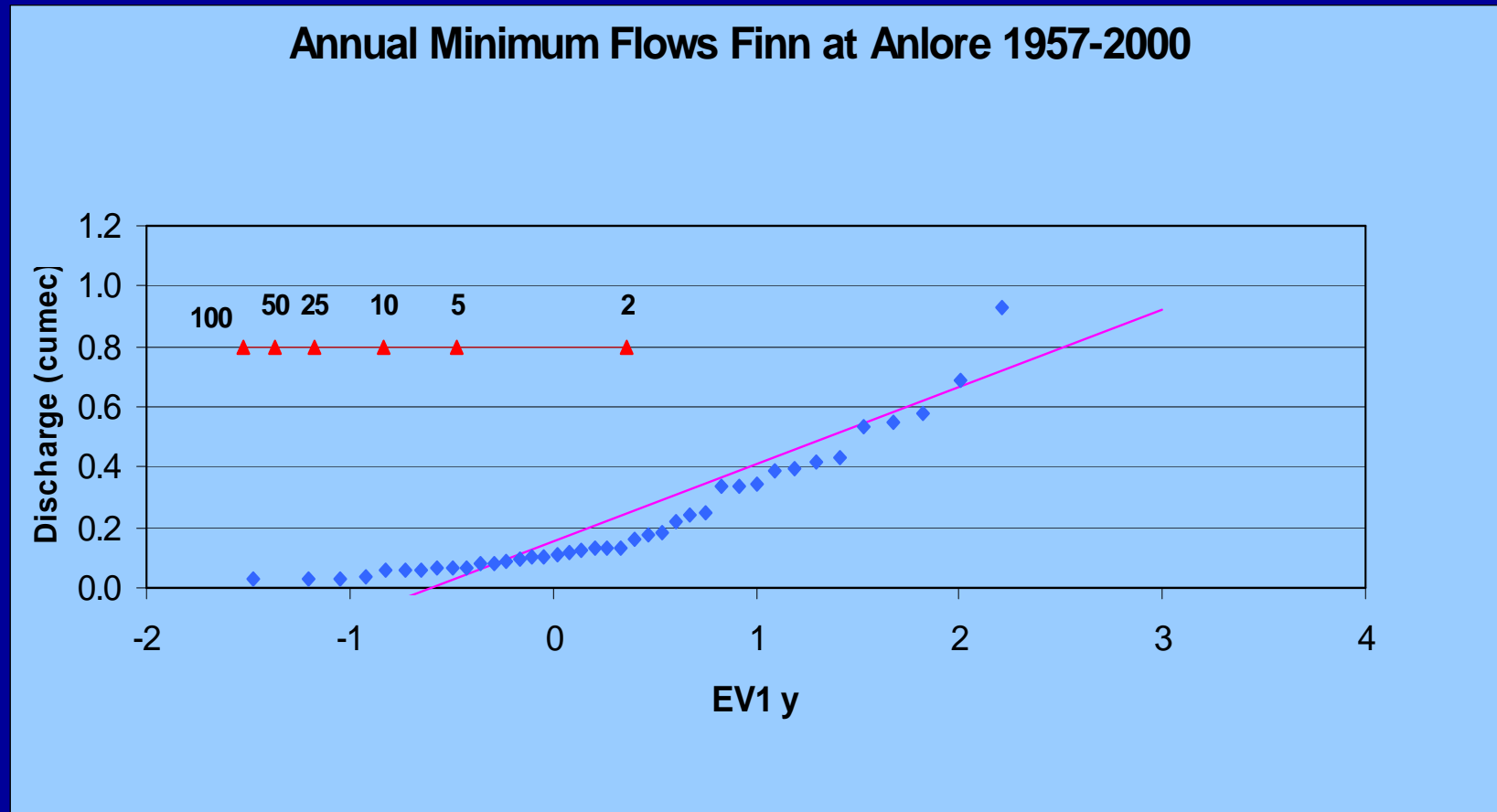
# Same data – Lognormal plot



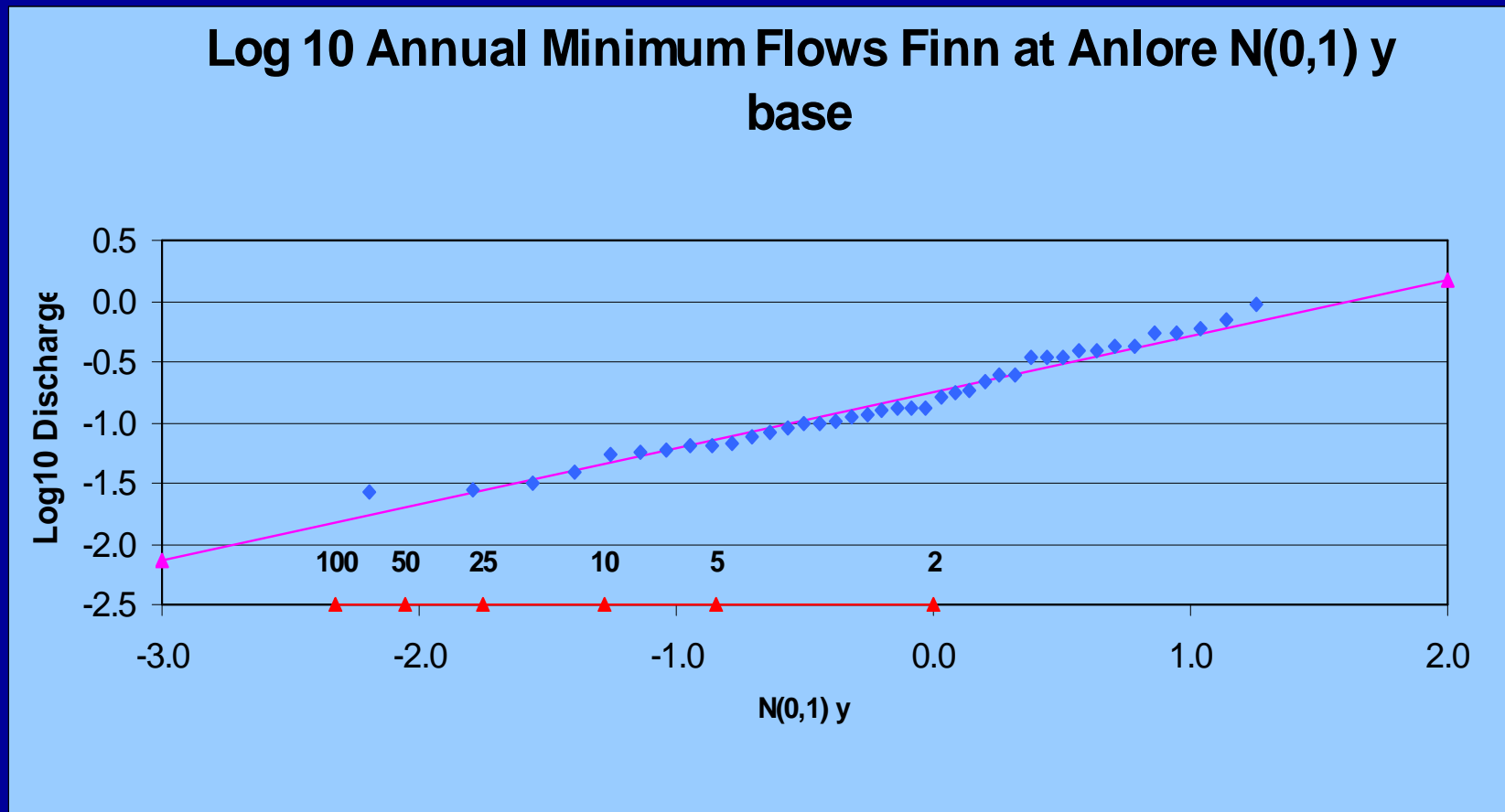
# Same data – descending order No Improvement!



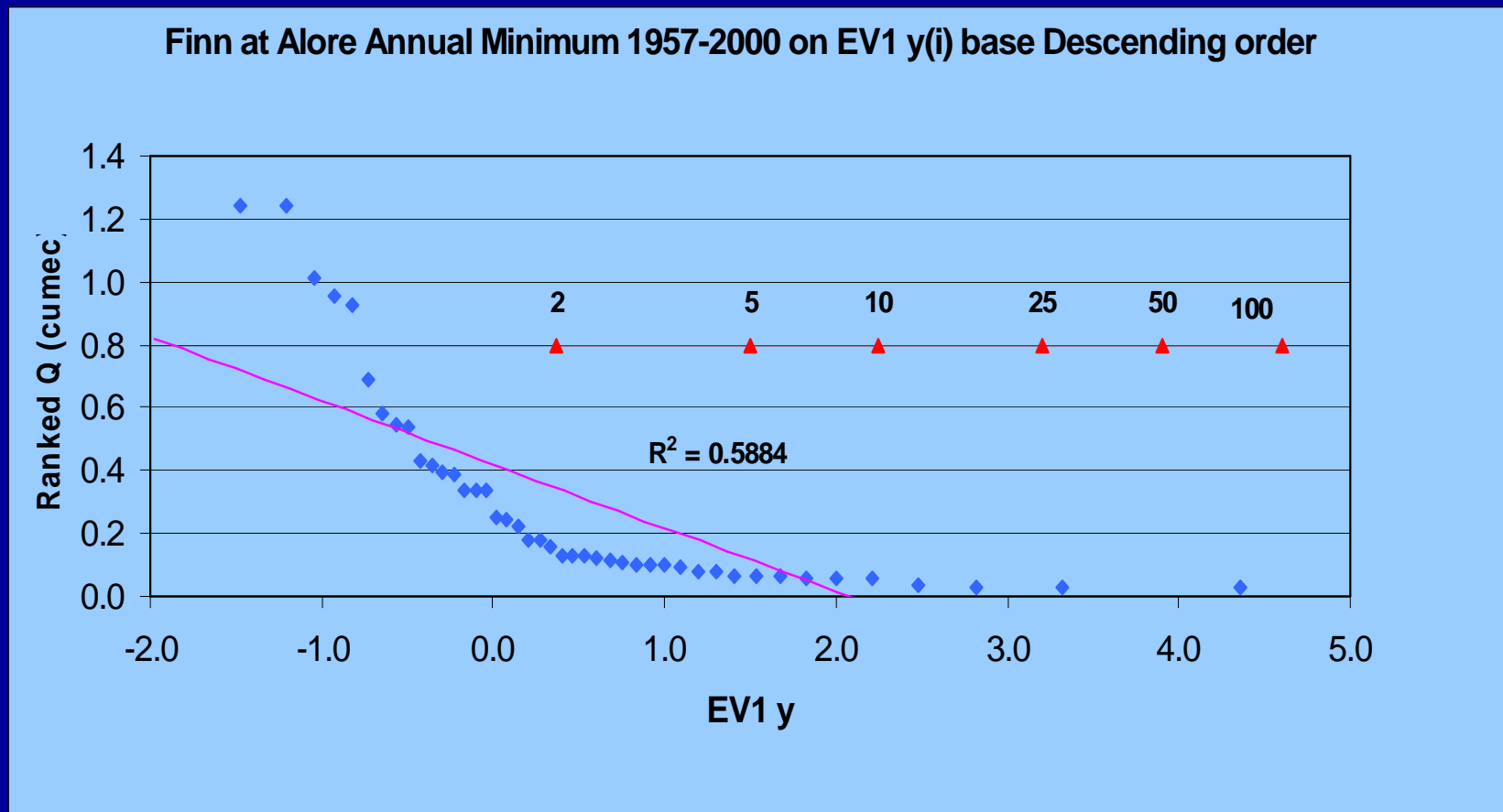
# Irish data – bad EV1 fit



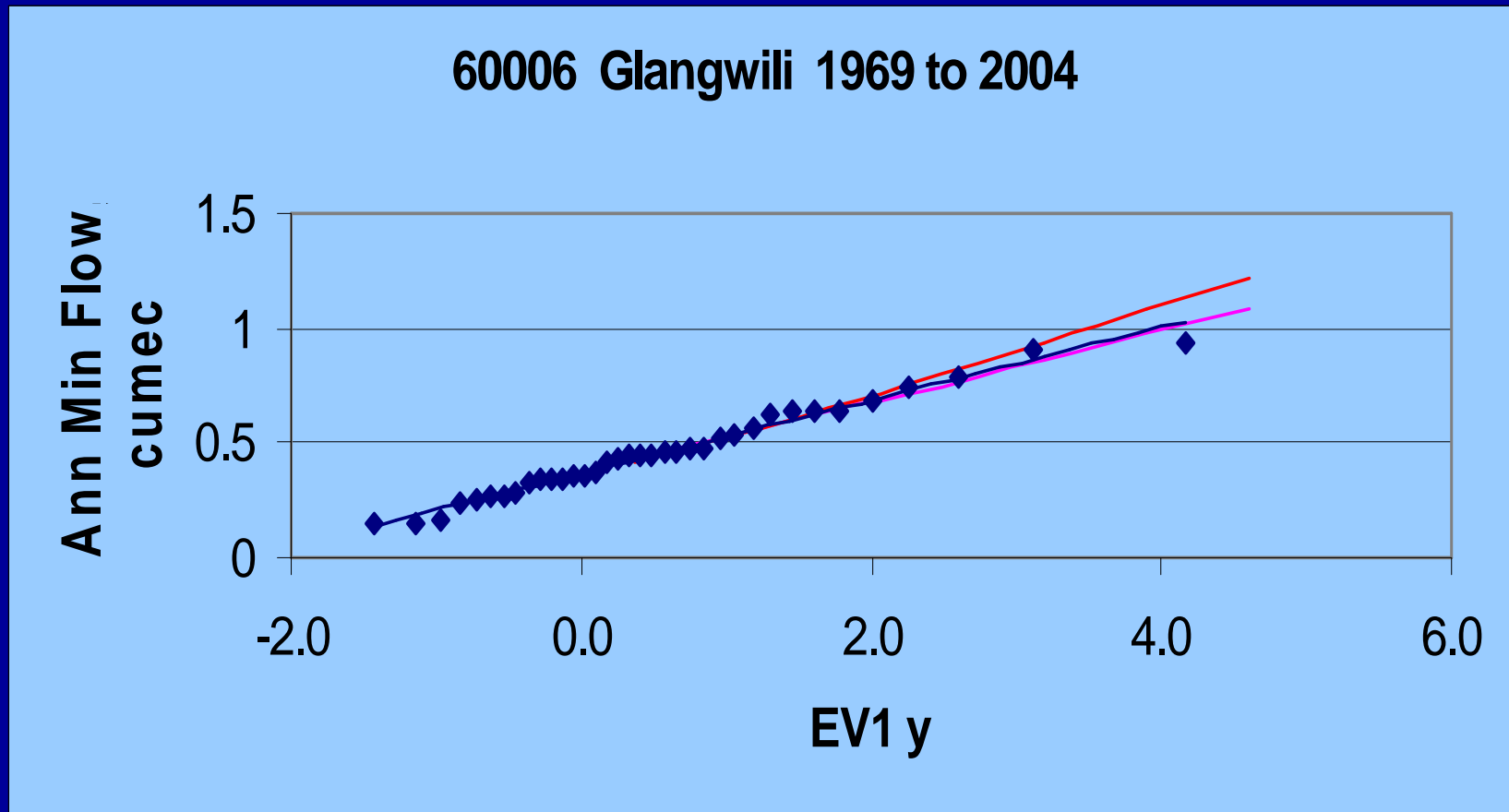
# Same data – Lognormal plot



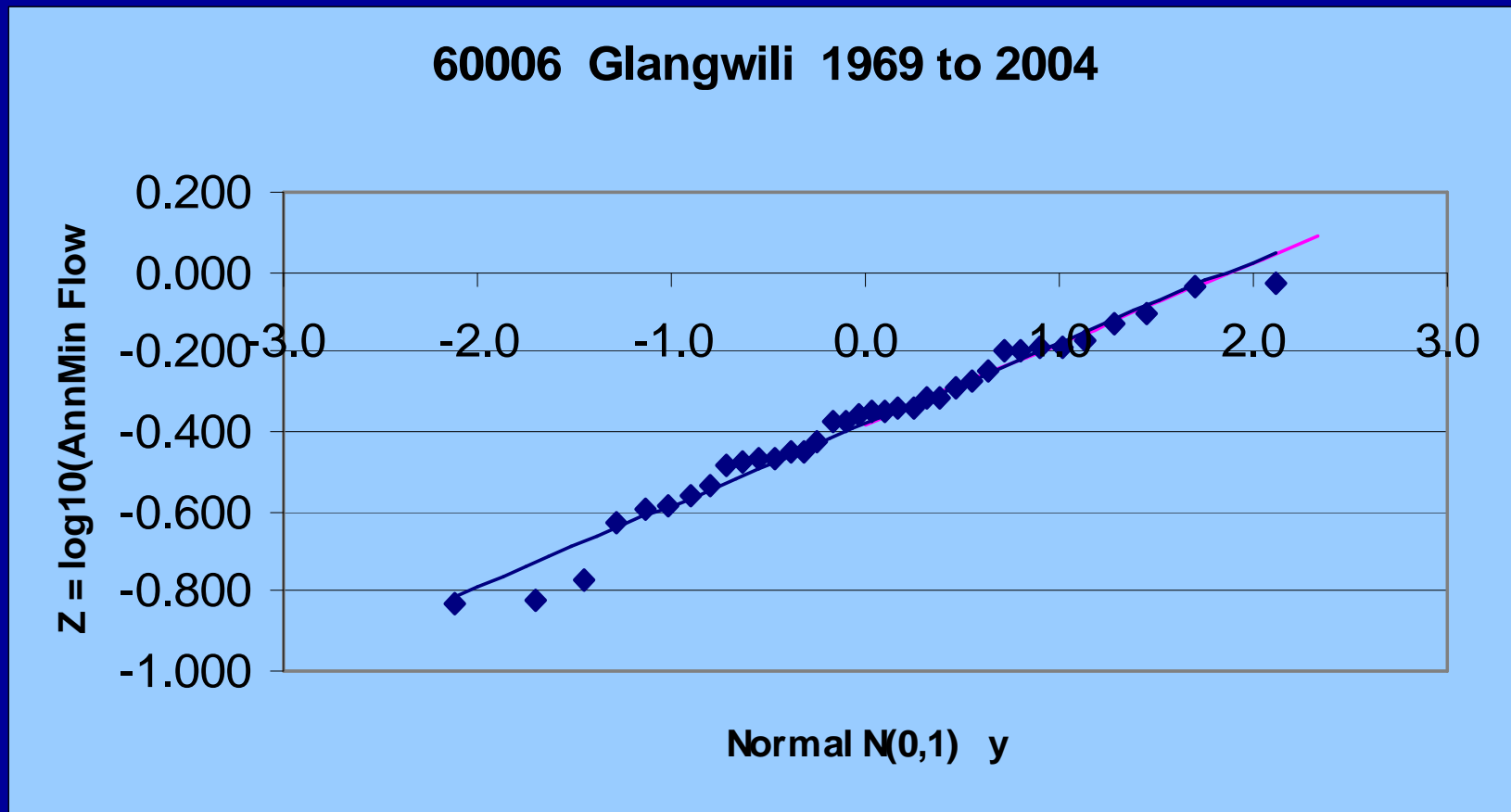
# Same data - descending



# Welsh data – EV1 plot



# Welsh data – lognormal plot



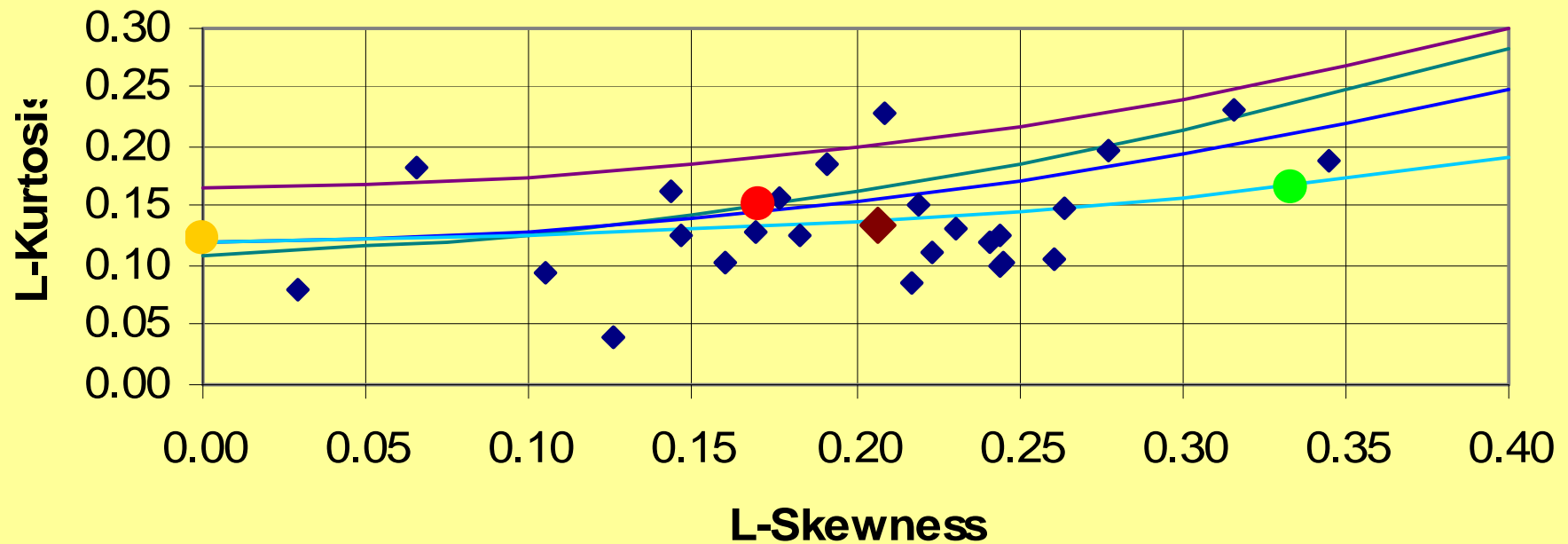
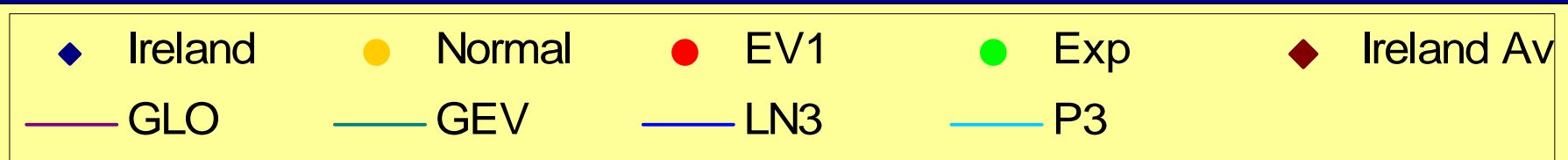
# Probability Plot Correlation Coefficients (PPCCs)

- PPCCs rejected the EV1 hypothesis in only 2 out of 28 Irish stations despite there being strong visual evidence that EV1 is unsuitable in 5 cases
- PPCCs did not reject the EV1 hypothesis in any of the 12 Welsh stations
- PPCC does not seem to have good discriminatory power

# L-Kurtosis versus L-Skewness

- The data from the 28 Irish stations show considerable scatter.
- This is not solely due to the poor EV1 fit in 5 cases.
- While L-moments are quite robust some data series have some very low outliers, i.e. almost zero flow, and these have quite an effect.
- Overall data quality is therefore an issue

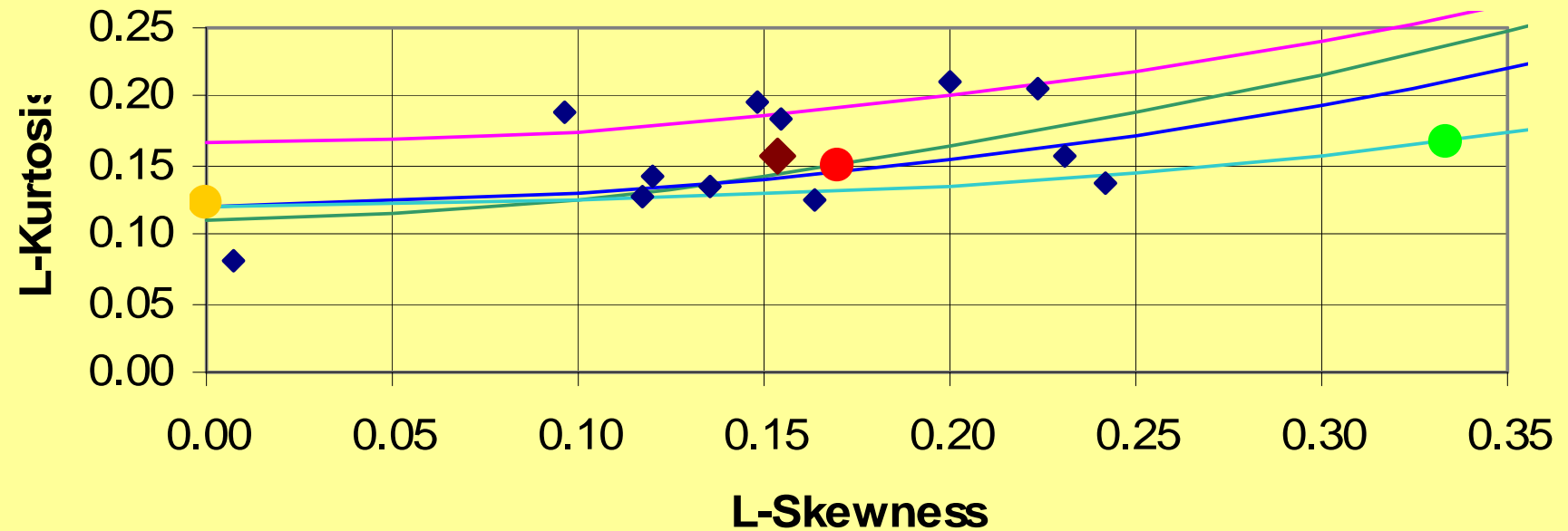
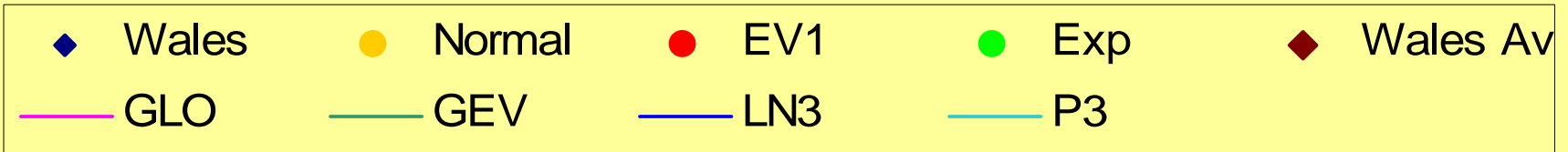
# Irish Data



# L-Kurtosis versus L-Skewness

- The data of the 12 Welsh stations show more scatter than would be expected from a 2-parameter parent.
- However the mean of the points plots very close to the single point which represents the EV1 distribution

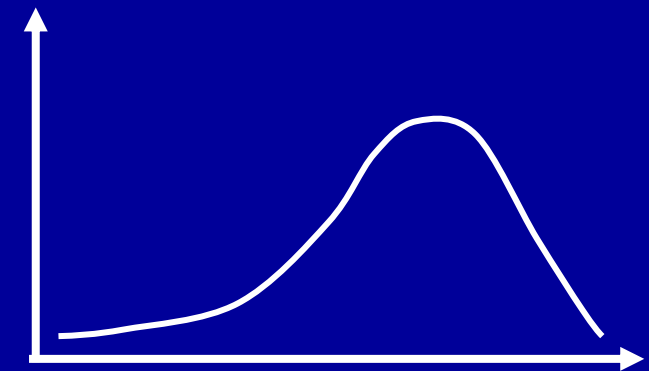
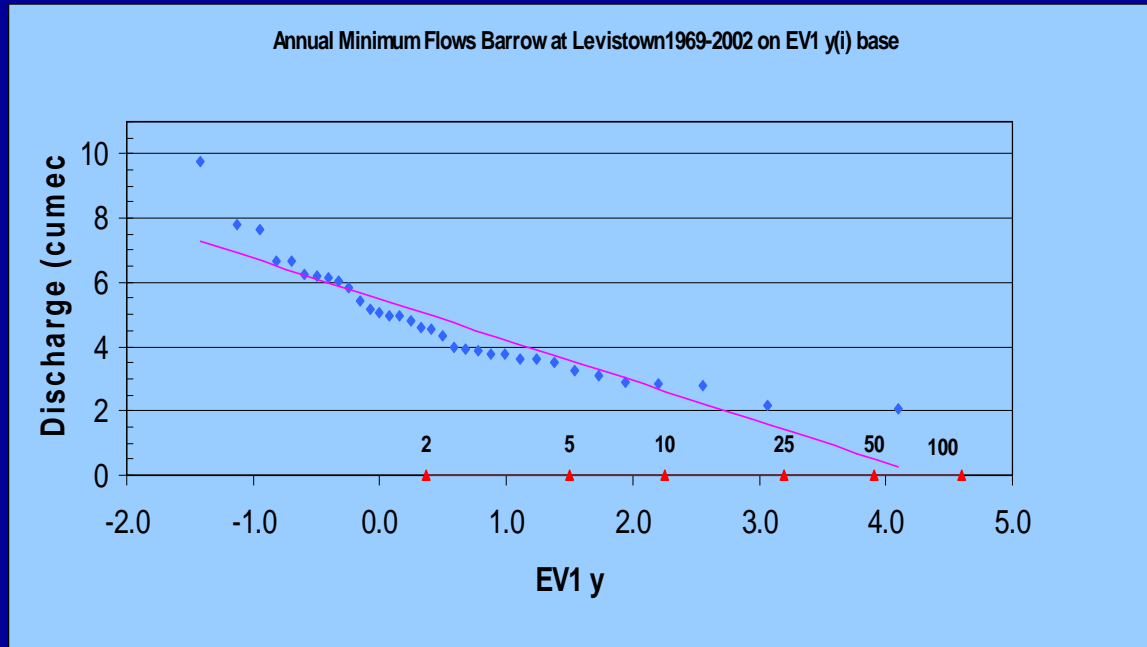
# Welsh Data



# Ascending or Descending Series

- Probability plots of low flows have often traditionally been shown with data ranked from largest to smallest.
- This was probably done so as to have the smaller values displayed where the return period scale is most elongated if an EV1 base is used.
- However this implies that the data have negative skewness, contrary to what has been found, and not surprisingly the probability plots do not display straight line patterns.

# Ascending or Descending Series



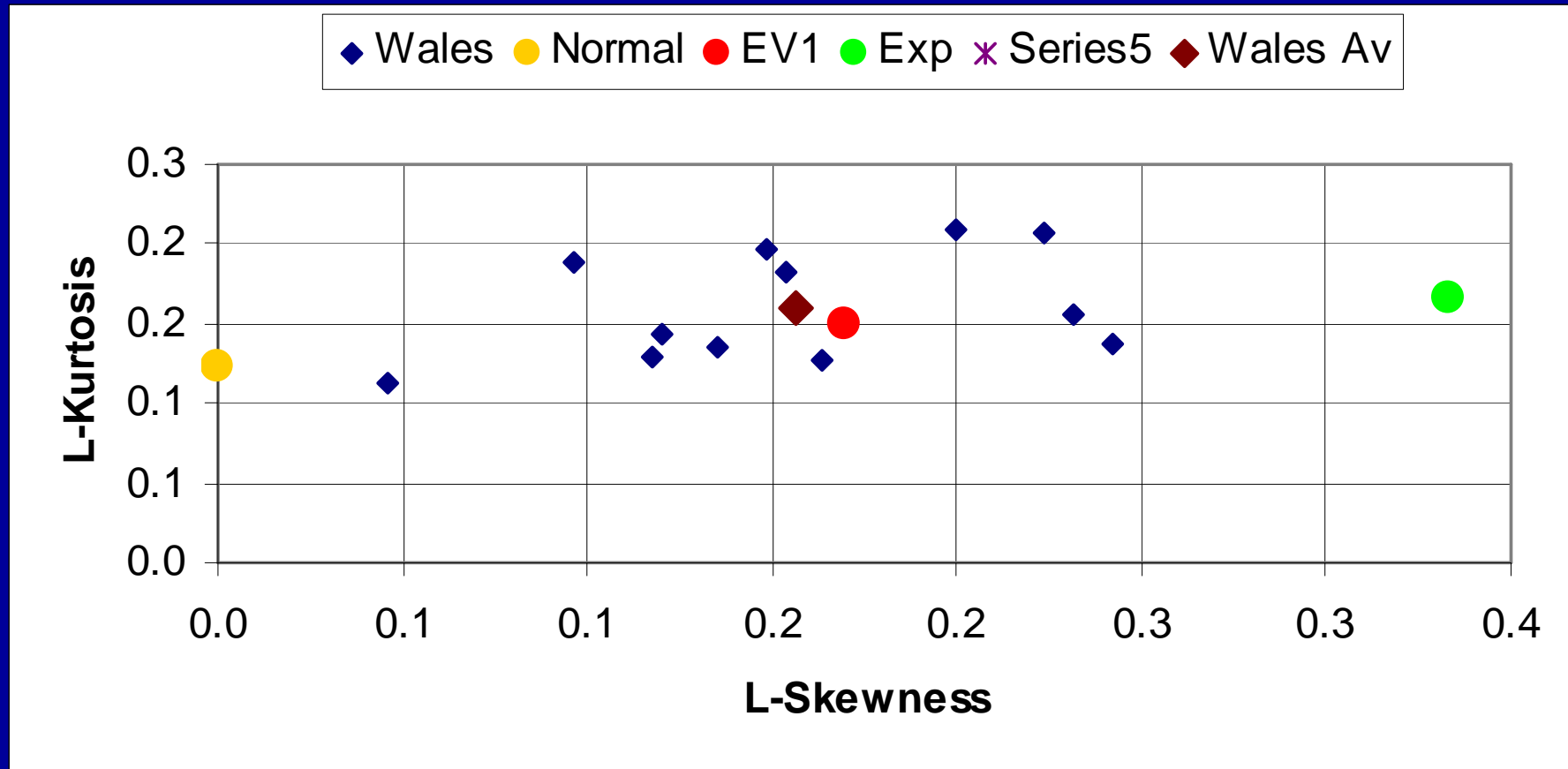
# Conclusions

- Skewness values support EV1 but do not rule out LN2
- Probability plots favour EV1 in all but 5 out of 40 cases
- However L Moment ratio diagrams do not support a single choice of distribution especially in the Irish case.
- Perhaps a single distribution may not be appropriate!

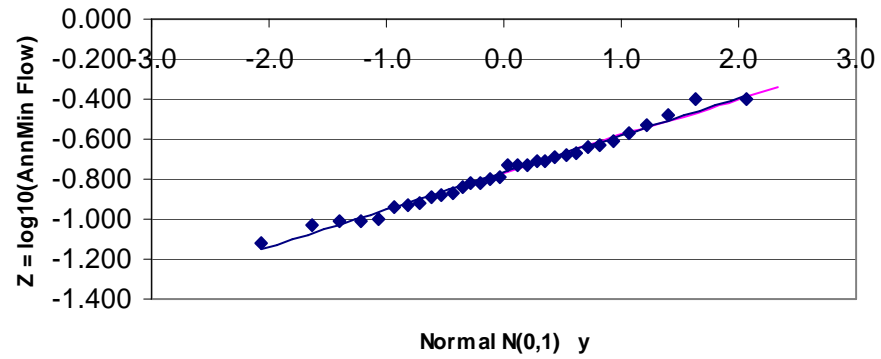
The End

Thank you.

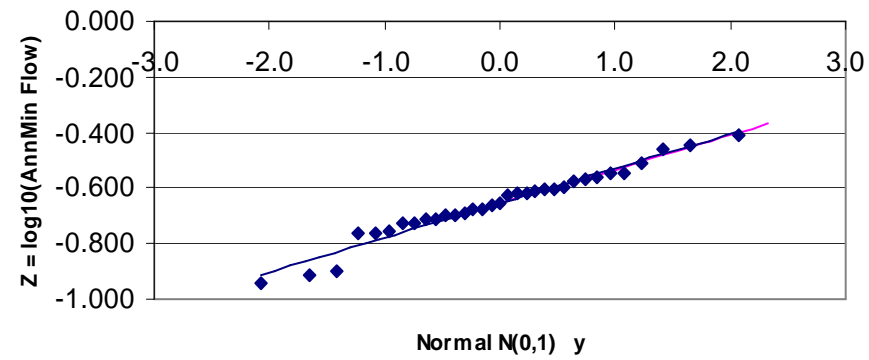
# Welsh Data



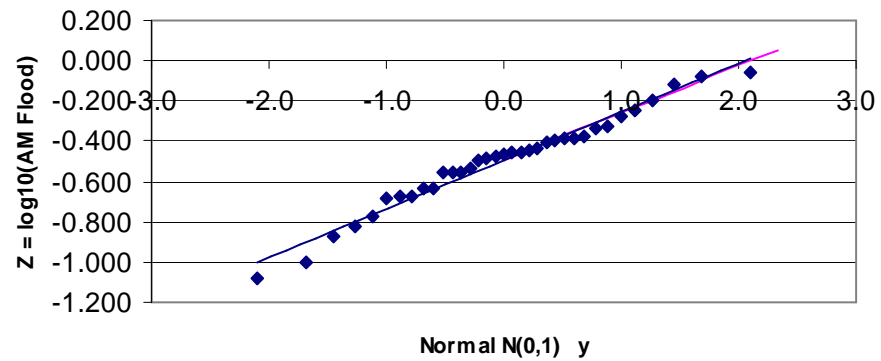
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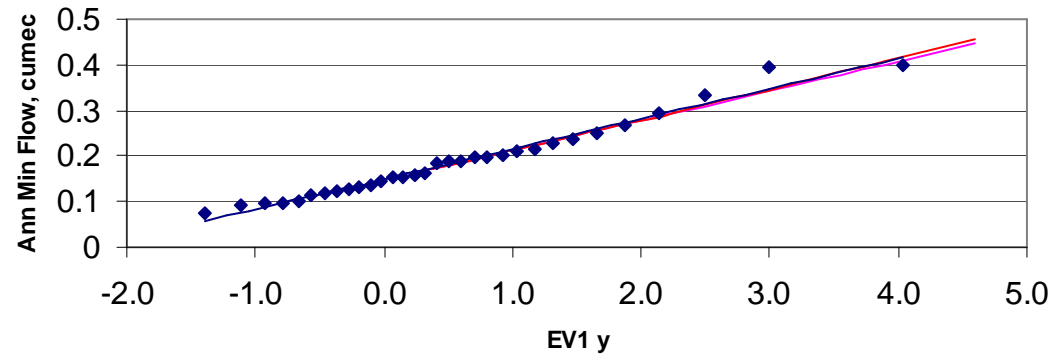
058008 Cilfrew 1972 to 2004



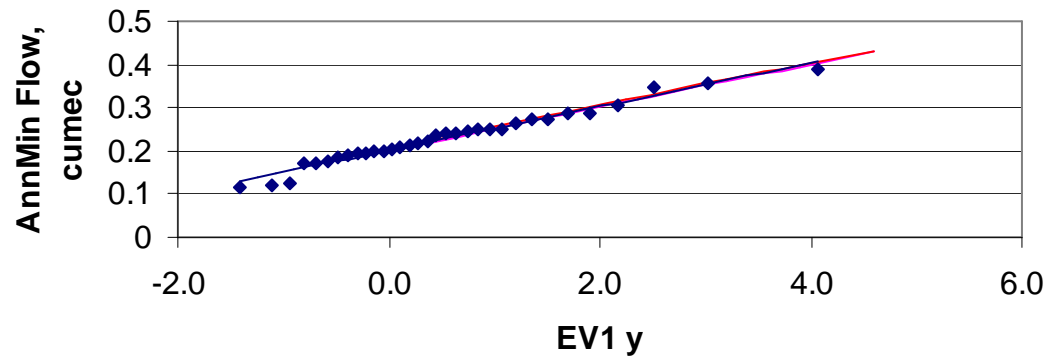
55026 Ddol Farm to 1970 - 2004



56013 Pont-ar-Yscir 1973 to 2004



058008 Cilfrew 1972 to 2004



55026 Ddol Farm to 1970 - 2004

