Salt on Baxter on Cutting

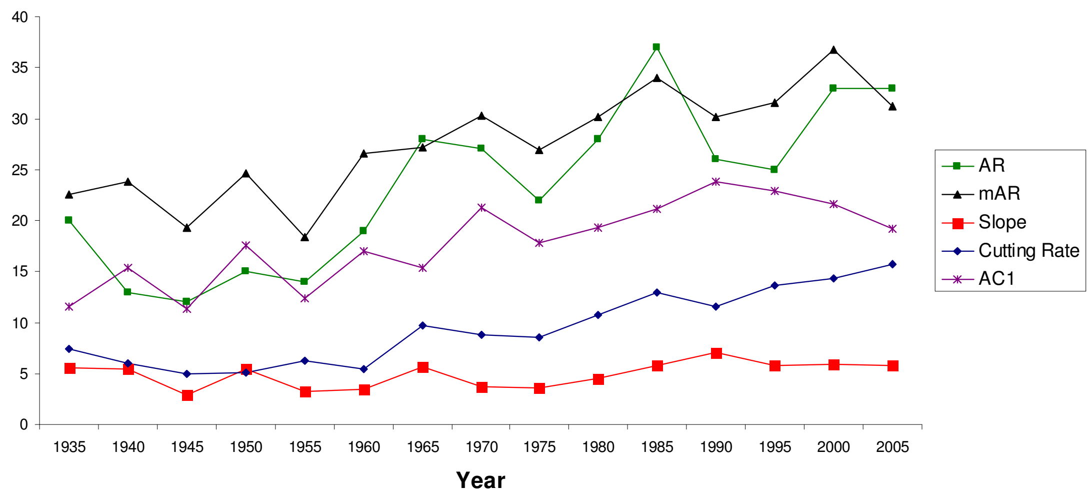
There is a simpler way of looking at the results given by Cutting, DeLong and Nothelfer (CDN) in *Attention and the Evolution of Hollywood Film.* It leads to almost the same conclusion as Mike Baxter's brilliant analysis in his *Evolution in Hollywood Editing Patterns*, but not quite.

All one has to do is take the average of Cutting *et al.*'s results for the ten films in each quinquennial sample, as follows:

Year	AR	mAR	Slope	Cutting Rate	AC1
1935	20	22.55	5.59	7.4	11.60
1940	13	23.87	5.43	6.0	15.34
1945	12	19.25	2.91	5.0	11.38
1950	15	24.59	5.44	5.1	17.60
1955	14	18.35	3.29	6.3	12.35
1960	19	26.54	3.44	5.4	16.94
1965	28	27.12	5.71	9.7	15.38
1970	27	30.31	3.71	8.8	21.23
1975	22	26.99	3.64	8.5	17.77
1980	28	30.17	4.46	10.8	19.31
1985	37	33.96	5.77	12.9	21.12
1990	26	30.19	7.10	11.6	23.85
1995	25	31.55	5.77	13.6	22.94
2000	33	36.71	5.94	14.3	21.59
2005	33	31.24	5.79	15.7	19.22

I am using all 150 of the films in the CDN sample, because I have corrected the negative shot length values that occurred in a small number of them. Here the 'cutting rate' is the average for each sample of 10 films of the average number of shots per minute in the films. That is: the cutting rate is equal to 60/ASL. The other figures for AR, mAR, and Slope are actually the averages from Cutting *et al.*'s figures multiplied by ten, so that I could get a neater layout on the graph for these figures. I have also added figures for the Autocorrelation coefficient of lag 1 (AC1), multiplied by 100. It is of course the *relative* values of these variables that matter in this context.

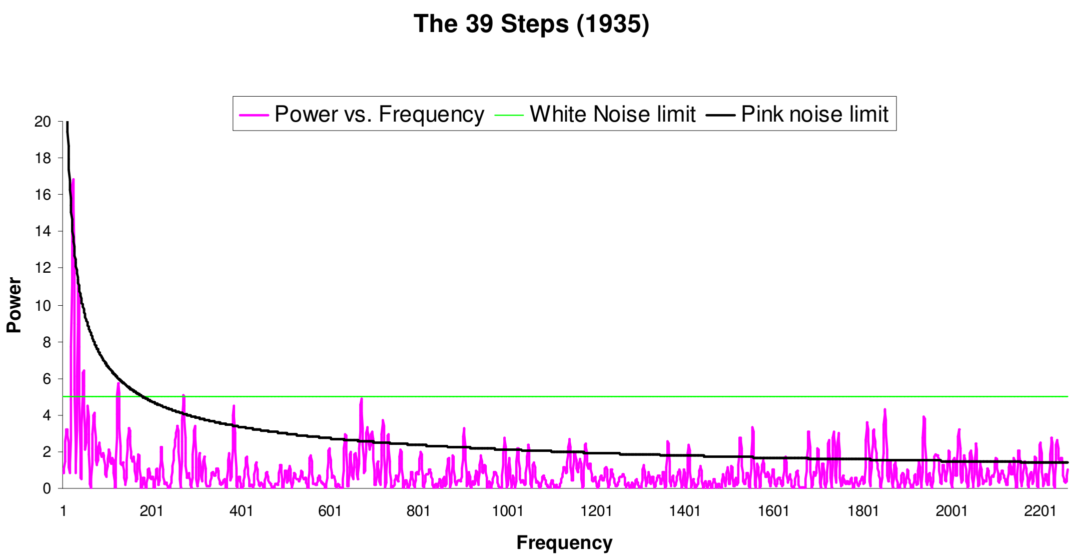
Average Cutting Data for Year



In this graphical presentation, the 'Slope' results are an alternative to that in Fig. 4 of Mike Baxter’s article, and you can see that there is no real increase visible in the coefficient ‘α’ of the frequency slope from 1935 to 2005, and indeed it stays around 0.5 over the years. To put it another way, it shows, as does Mike Baxter's more thorough investigation, that there is indeed no evolution towards a value of unity for α, which is the basic claim made by Cutting, DeLong and Nothelfer.

Both CDN and Mike Baxter refer to the difficulty of using time-series analysis on shot lengths due to the existence 'noise' in the data. This seems to me indicative of a possible mistake in applying standard time-series statistical techniques to film shot length data. These techniques were developed for things like isolating the radio-frequency measurements representing, say, the signal from a pulsar from the 'noise' representing the measurements of radio frequency signals from all the other astronomical sources. In such cases it is usually possible to eventually show by various other means that there really *is* a special signal amongst all the other noise. Likewise in using time-series analysis in other areas. In such cases the observations are a sample from a series that continues indefinitely. This is not the case with film shot lengths, which represent a limited number of results particular to each film. And strictly speaking, all the shot lengths are signal, and none of them are noise, since their was a series of more or less conscious choices to make the shots the length they are.

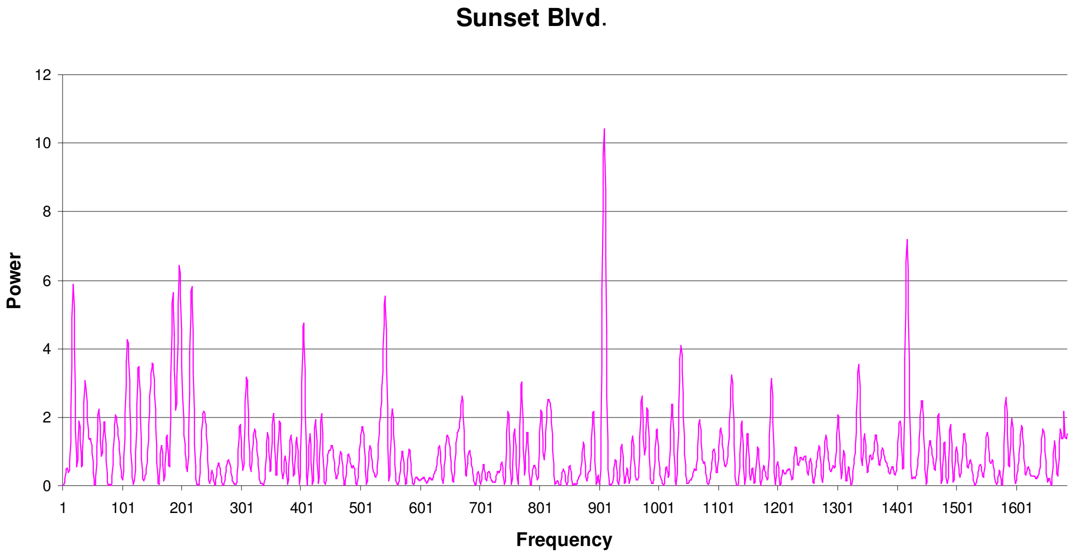
In the case of shot lengths, the time series approach manifests the 'signal' and 'noise' in the form of a Fourier transform of the values of the original series of shot lengths to what is called a 'power spectrum', as in this graph for *The 39 Steps*:



The values are considered to fall into two parts; the 'white noise' part under the green line, which is made up of approximately random values with an upper limit on the 'power' of these values, and a 'pink noise' part, which lies under the black curve.. This is the signal that is being identified as meaningful by CDN. It is an envelope for the part of the results that, unlike the white noise part, has values that change with their particular frequency. The first obvious problem with this process is how does one identify which values relate to which part of the division into random and non-random values. The second difficulty is in determining the mathematical shape of the envelope containing the pink noise part. In the case of *The 39 Steps* there is clearly a group of low frequency values standing out above the white noise part of the spectrum, and I have fitted a curve to these by eye, not by the methods used by Cutting, DeLong and Nothelfer.

In fact the best fit I could get has the equation Power = 1/(Frequency)$^{0.5}$, with slope 0.5, not the 0.91 slope that CDN get by their method.

But for many films in the sample, there is no obvious pink noise part of the power spectrum graph, as in the case for *Sunset Blvd,* here:



There are no values at low frequencies obviously representing pink noise standing clear from what looks like nothing but random white noise to me. Seen from this perspective, the failure by Cutting, DeLong and Nothelfer to find any systematic evolution towards 1/*f* patterns is not so surprising.

However, I think it is obvious that CDN *have* found a real upward trend with time in the data for their Autoregressive index (AR), and also for their 'modified Autoregressive index' (mAR), and Mike Baxter has found a similar trand for the Autocorrelation coefficient of lag1 (AC1), as you can see in my initial graph of cutting data.

What is interesting to me about the AR figures is that they have the same trend as the cutting rate over time, and there is even a dip in the AR paralleling the dip in the Cutting Rate from 1940 to 1955, during the period of the Hollywood long take craze. The actual relation between the Cutting Rate and the AR values is quite close throughout, with a Pearson correlation coefficient of 0.89. The relation between the mAR figures and the cutting rate is slightly less close, with a correlation coefficient of 0.84, which is mostly because the mAR figures do not show the 1940 to 1950 dip clearly.

So, as I have said before, I would still explain the increase in the Autoregressive index as a consequence of the increase in the cutting rate (or decrease in the ASL) over the last 80 years, and hence that there has come to be more and longer chains of shots of roughly equal length in films. The increase in chains of roughly similar length shots is because these chains are within scenes, and since the average number of scenes in a film, and hence their length, has stayed the same over time, there are now more shots in a scene. In the fast scenes the shorter shots tend to be more nearly the same length the faster they get. The different expressive cutting treatments of film scenes is explained and illustrated in my article "Speeding Up and

Slowing Down" in the Measurement Theory section of the Cinemetrics website. And all this applies to all kinds of mainstream features, not just action films.

However, what we have here is a trend or tendency shown by averaging over a number of films, not a direct link between the Autocorrelation coefficient of lag one (AC1) (which is also the Partial Autocorrelation coefficient of lag one) and the Autoregressive index for individual films. This can be seen by looking at pairs of films from the CDN sample that have nearly the same AC1, but different AR values. For instance, take the values for *Mr. and Mrs. Smith* and *Hitch*, both from the year 2005, where I quote the AR, the mAR, the ASL, and the Autocorrelation coefficients of lag 1 (AC1).

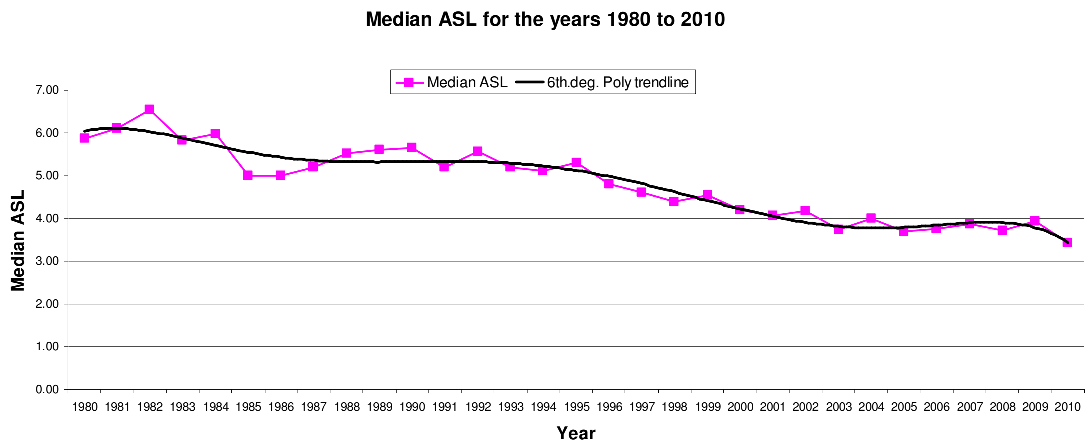
Film	**AR**	**mAR**	**ASL**	**AC1**
Mr. & Mrs. Smith	4	3.64	4.1	0.21
Hitch	2	2.81	3.9	0.19

The Autocorrelation coefficients are both close to each other, whereas the AR and mAR values are markedly different for the two films. So when looking at particular films, the Autocorrelation coefficient of lag 1 can not be simply substituted for the Autoregressive index (AR) or an mAR without losing some potential information about the shot length patterns in the films.. The existence of this additional information about patterns of relatively equal shot lengths can be illustrated by quoting the Autocorrelation coefficients of all lags up to 10 for *Mr. and Mrs. Smith* and *Hitch.*

Film	**AC1**	**AC2**	**AC3**	**AC4**	**AC5**	**AC6**	**AC7**	**AC8**	**AC9**	**AC10**
Mr. & Mrs. Smith	0.20	0.20	0.16	0.16	0.10	0.10	0.9	0.11	0.06	0.08
Hitch	0.19	0.11	0.08	0.07	0.05	0.08	0.08	0.06	0.06	0.10

The values of the Autocorrelation at higher lags fall off towards zero much faster in the case of *Hitch* than with *Mr. & Mrs. Smith*, which should have something to do with the latter having longer strings of shots with roughly equal lengths. So the use of the overall increase of faster cutting merely provides the option for the film makers to do this, not the necessity. And hence we have a stylistic difference between the two films, even if it is perhaps merely a generic stylistic difference. After all, *Mr. & Mrs. Smith* can be classified as an action film, while *Hitch* is a romantic comedy. Anyway, it may be possible to represent this stylistic difference analytically by using something other than the AR model; perhaps an MA model.

The CDN sample of 150 films does not show the increase in the cutting rate slowing down into 2005, but the latest figures for my vastly larger collection of 3436 ASLs for American films made from 1980 to 2010 prove that we are still on another plateau covering the years 2002 to 2009, as you can see in the following summary graph. (The downturn in 2010 is quite possibly not reliable, as there is a decrease in the number of films counted per year from 2002 to 2010, from 130 to only 66 films in the latter year. As more figures come in, this downturn may well vanish.)



Since the general cutting rate of American films has stopped increasing from 2003, I predict that an analysis of the AR and 1/*f* figures for the top ten Box Office films from 2010 will show no increase from those that we already have for 2000 and 2005. If anyone wants to do it, these are the top ten Box-office American films for 2010:

Toy Story 3
Alice in Wonderland
Iron Man 2
The Twilight Saga: Eclipse
Harry Potter and the Deathly Hallows Part 1
Inception
Despicable Me
Shrek Forever After
How to Train Your Dragon
Tangled

Mind you, it has to be a frame-accurate recording, given the cutting rates in these films.

Barry Salt, Good Friday, 2014