Other Impacts on VHF Contests

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Introductory Remarks. *Technological and regulatory impacts upon VHF contesting participation levels have been well-documented (Tilton, 1959 and 1960; Roseman, 1991; Kaufhold, Trends I and Trends II). Many other factors have been discussed, but have not been as thoroughly researched. The purpose of this document is two-fold: 1) to identify and examine the various "other impacts" that have possibly influenced the world of VHF contesting; and 2) to provide more of a statistical basis in which to examine the various impacts upon VHF contest activity levels.*

This paper was originally written in August of 2004, and has been revised and updated several times thereafter. Updates to the original document are noted throughout the paper.

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Part I – Discussion of Other Impacts and Trends Affecting VHF Contesting

Participation and Log Entry Rates. The Final Report of the VHF Awards Sub-Committee (Frenaye, 2004) issued some interesting numbers on participation levels in the VHF contests. Since 2001, there has been an average of 4,500 stations logged in the contests, even though there were only 500 to 800 log entries in the main three VHF contests. This represents a 5:1 to 7:1 ratio. The low entry submission rate has long been rumored, but never publicly confirmed, to my knowledge. In reviewing data so kindly supplied by the VHF Subcommittee chair, Tom Frenaye, K1KI (Attachment 1, Final Report; additional data on specific contests), the January VHF SS has had between 3,500 to 4,200 stations active since 2001; the June QSO Party, between 4,600 to over 6,100 non-unique call-signs logged; and in September, 2,900 to 4,400 operators made contacts.

There is too little data yet available to tell if log entry rates have either gone up or down in response to factors such as the solar cycle, weather and band conditions, and so forth. The log entry ratios have been fairly consistent, for each contest in the 3 to 4 years of available data: January has a 4.50:1 to 5.10:1 ratio; June has 6.93:1 to 7.35:1; In September, 5.39:1 to 8.45:1 (the largest variance internally to each contest); and the UHF, at 3.12:1 to 3.58:1. The June 2003 had a slightly lower ratio than did the 2001 June two years before, even with the excellent band conditions in 2003, so great propagation did not result in a higher log entry rate in that one contest. Each contest may be generating its own tight range of log entry rates, although it will take many more years of data to determine why (and if) that is really occurring.

These numbers produce several intriguing thoughts, though. The simple fact that only 1 in 5 to 1 in 7 people on the bands will be actually competing with each other during a contest is rather amazing. To do well in a contest then, one should obviously engage in a dual track strategy: scoop up all the casual operators that can be found on the bands (especially on 6 and 2 where most of the occasional operators hang out); and then concentrate on the serious contesters with multi-band capabilities.

As to a general level of band activity, the highest number of call-signs occurred in June, 2003, with 6,110 non-unique call-signs contained in the contest logs. This number may thus represent a basic core of VHF operator activity, which is very important for documentation purposes in the years ahead. With over 6,000 call-signs active on a summer contest weekends (and an average of 4,500 active in the three main contests), amateur VHF activity is alive and well.

Most importantly, the participation levels are so vast when compared with log entries, that one must wonder why so few people making contacts in the contests will then submit an entry. It's simply an astonishing set of numbers. The identification of factors affecting log entries must therefore also take into account the probable impacts upon general participation levels. Quite possibly, the same technological / regulatory / demographic factors that have been driving the large variance in log entries over the years also has had an impact on overall participation levels – as the log entries have gone up and down, so

too may have general activity levels risen and fallen. Or, changes could be occurring in log entry numbers without any shifts in activity levels (and visa versa).

10-04 update: In correspondence subsequent to the initial publication of this article, Tom Frenaye, K1KI, advises that the HF participation to log entry numbers are similar to the VHF ratios. This would tend to indicate that the log entry percentages are not unique to VHF contesting, but are more typical of all type of ARRL contesting events.

9-2005 Update: CQ VHF log entry numbers are vastly different than the ARRL percentages. The call to log entry ratio for 2003 and 2004 may be as high as 30:1. Even after considering only callsigns that appear in two or more logs, the call to entry ratio in 2003 was 14.8:1. The extraordinarily high percentage may be a reflection of two things: 1) with only a 6 and 2 meter format, the CQ contest may be attracting many more casual operators with HF + VHF rigs than does the ARRL events; 2) many world-wide participants in the CQ VHF contest may be making contacts, but are then not submitting a log.

Unique Calls. The above statistics on total and average station activity during the VHF contests have been screened for unique call signs (Frenaye, correspondence, 2004). The call-signs appearing only once in a master data-base of contest logs will almost invariably be "busted", and therefore not provide evidence of a real station contact. These types of unique call errors are rather easy to identify, by computer review of the log data-base. But, calls appearing two or more times in a master log data-base can still be broken. This occurs where two or more contest operators simply miscopy the same call in the same way (W9GKA may be read as W9GCT on CW, for example, especially where the sender – i.e. me - is consistently sloppy on a straight key). These kinds of uniques can be a sizable percentage of the log data-base at times, and they are more difficult to identify (Zimmerman, correspondence, 2004). Even if they are compared against a FCC type of call-sign data-base, the calls that are miscopied repeatedly in the same way may not be identified as broken, since the misread call-signs could themselves be registered as valid call-signs assigned to existing amateurs.

This type of "double" misread call may not be a huge problem in the VHF contest, since the VHF community is generally a tight knit bunch. Many of the local VHF ops are so well known that their calls might be accurately logged even if the call letters are miscopied slightly. This entire issue of unique calls should be kept in mind, however, as we more thoroughly sort through participation versus log entry rate issues in the coming years. Conceivably, the participation levels cited in Attachment 1 of the Final Report could be somewhat higher than true conditions, due to various uniques being treated as legitimate. It's really part of the classic statistical problem of sample collection – how close is the sample to the true population? It's something to keep in mind.

Rules Regime. Many people have believed that the contest rules themselves have, at times, discouraged contest participation. There have been complaints in the past that the VHF Rules set has remained stagnant in the face of regulatory and technological change (Lindholm, 1981). More currently, there are several recurring observations as to the

rules: there is a lack of variety in the main ARRL contests; the pace of the contests is slow and boring; the contests are too long; the rules are overly complicated and involve three separately published rules sets; the current all-inclusive nature of the contests discourages many casual and beginner amateurs; and that the current scoring methodology favors microwaves to the point of discouraging overall participation levels. Many of the complaints are summarized in the Final Report, 2004; Jones, 2003; and Zimmerman, 2003.

Perhaps the best way in which to evaluate and measure whether the rules themselves will adversely (or positively) impact participation levels is to review the major changes that have occurred in the rules and then look at log entry levels to estimate the possible impact. In particular, several scoring methodology revisions and category changes have occurred over the years that have dramatically changed the nature and format of the VHF contests. By looking at these major structural changes, we can better gauge the overall impact to participation levels. Reviewing the impacts regarding microwave usage would also be appropriate, in light of the numerous concerns expressed on that topic.

As to scoring changes, numerous small and large changes have occurred since the formation of VHF SS and VHF QSO Party systems in 1948. (Kaufhold, VHF Historical Notes, provides an in-depth description of the VHF rules since 1948). Initially, the January VHF SS and VHF QSO Party scoring methods were vastly different. The VHF SS was patterned after the HF SS, with contacts and sections being worked only one time for credit, and there were no QSO points awarded for any band, only contacts. The QSO Parties were based on QSO points and sections for each band.

The scoring portions of the rules went relatively unchanged for many years thereafter. Then, in 1978, the January VHF SS added QSO points for the first time, and they were much more generous than in the VHF QSO Parties. In 1983, the League adopted the use of grid squares as the multiplier instead of ARRL sections. Widespread usage of grid squares occurred very rapidly both in the United States and abroad, and along with the implementation of the VUCC program, the changes were warmly received in the VHF community. General activity on the VHF bands was fundamentally changed by usage of the Maidenhead grid squares. Thereafter, minor changes continued to take place to the scoring provisions of the rules. Currently, the scoring procedures have become almost identical, with only small differences between the VHF SS and the VHF QSO Parties.

In reviewing these above scoring changes, fundamental shifts occurred in 1978 with the adoption of QSO points in the January VHF SS and then again in 1983 with the development of grid squares as the multiplier for all contests except the 10 Gig (which used a distance measurement). How have these two major changes in scoring affected participation in the VHF contests?

Log entries bottomed in 1975 with a low of 590 entries in the January VHF SS, after having eroded from 980 entries in 1971. Then, we had five consecutive years of strong growth up to 987 entries in 1980, and then stability of log entries through 1983. As to the QSO point change in the VHF SS, there is nothing that jumps out of the numbers starting

in 1978. The only number of a major import was the 1975 low point in log entries. By the time that QSO points were introduced in the January SS, the upward swing to the numbers had already been occurring for two years. The 1975 low point has been traced to technological and regulatory changes then underway (Roseman, 1980; Kaufhold, Trends I).

As to the dramatic move to grid squares in 1983, log entry numbers for all three major contests either remained fairly stable to stagnant (September) to actually declining until 1991 (January and June). Even though the developments of the grids and the VUCC were instant hits with everyone, log entries went down for the next eight years.

The evidence therefore suggests that these two major changes in scoring methodology did not generate quantifiable numbers of log entry increases, even with wide acceptance and approval of one of the changes, that of the grid squares.

As to category changes, the rules in 1948 initially contained only one class – that of single-op. Contestants immediately began to assist each other, however. Multi-op crews were making major contributions in all the contests by the early 1950's, regardless of there being only one class for formal section level awards. In 1954, multi's were added to the QSO Party format as a separate category. Only these two classes existed from that time until the late 1980's.

The QRP Portable category started in the September VHF QSO Party of 1986, was added to the June VHF QSO Party in 1987, and to the January VHF SS in 1989. Faced with the less than a competitive situation among the multi's (W2SZ and a few others then dominated the multi category), multi-ops were split into two separate categories in June 1991, the Multi-Unlimited and Multi-Limited.

Additionally, many people were then engaging in mobile activity, submitting multiple scores in the same contest from numerous grid squares, and sometimes in different classes. Mobiling around the countryside became increasingly popular, and a separate rover category was added, also beginning the same time as the limited class, in June 1991. The scoring system for the new rover class proved to be controversial since it produced a "mega-scoring" potential by the rovers. This potential was actually realized in the January 1993 contest, when the January club competition being greatly affected by two sets of rover teams submitting entries for the Hampden County Radio Club. To deal with the matter, the "W3EP rules" changed the scoring system for the rovers, and was quickly placed into effect for June, 1993. These rules were greatly objected to by the rovers as overly dampening rover scoring potential. Modifications to the scoring system once again occurred in January 1995. This settled down a bit thereafter, but the controversy never completely died out.

Interestingly, by the mid 1990's, the CQ VHF contest had implemented the original or "classic" ARRL rover rules into its contest structure. In 2004, the VHF Awards sub-committee proposed a return to the earlier rover scoring rules in an attempt to stimulate activity levels. By this time however, many rovers had grown accustomed to the 1995

rules, and there was a mixed reaction to the proposal. Further, many clubs (including the SMC) objected to the proposal since rover scores were to be completely prohibited from the club aggregate score. Most clubs currently utilize rovers to some extent for their aggregate scores, and a total ban on rover scores was not well received in some clubs. The sub-committee ultimately withdrew its proposal regarding the rovers.

Effective January 1, 2000, the Single-op category was split into high and low power classes. The QRP Portable category had a name change effective September 2000 to "Single-Op Portable", with only slight clarifications occurring in the category's composition.

How has category expansion affected log entry submissions? Let's review by looking at things in chronological order. The multi-op class began at such an early stage in contesting that for all practical purposes, there have been two basic classes for the very large bulk of contesting history.

Category expansion started in the 1986 with the adoption of the QRP portable class. This has been such a tiny category that it has had no substantive impact on the contests. However, due to its small size, it has been an ideal category to study, and as such, has become a most heavily analyzed area both in quantifiable terms (Kaufhold, QRP article 2004) and in qualitative approaches (Witte, 2004). As to both point production and log entry participation, the QRP class has been affected by the same demographic trends as the national statistics, with large dips and peaks in QRP logs corresponding with the national numbers. The category has developed a dedicated and loyal following of "regulars" that frequently inhabit and support the class. In this regard, QRP attracts a following just as the EME contest does, with its own "usual suspects" of participation (This reference to the movie *Casablanca* comes from the 2000 EME write-up, *QST,* May 2001, on-line version). Thus, the category can be seen as providing added texture and variety to the VHF contests.

The next category to develop was the multi-limited in June 1991. This class has been preferred by many small multi groups, but there has been no dramatic increases in log entry numbers. Currently, the January VHF SS has somewhat lower log entry numbers for both unlimited and limited than when the category was first formed some 13 years ago. In the June contest, there has been almost no change in total multi-op log entries (91 in 1991 versus 93 in 2003). But in September, the number of unlimited entries has risen (from 20 in 1991 to 29 in 2003) while the number on the limited has fallen (from 46 to 34), resulting in almost no net change in the log entries for all multis. While the primary goal of the multi-op rules revisions – providing the smaller multi efforts with the ability to compete more effectively – may have been served by the rules changes, there has been little or no increase in total multi-op log entries.

The rover class has had a huge impact, however. Log entry numbers on the rovers in the January VHF SS have more than doubled since 1991; the rovers continue to increase their numbers in June (up to 92 entries in 2003); and rovers have also increased their ranks in September (from 74 in 1999 to 93 in 2003). This is in spite of the absence of many

seasoned rovers and a general loss of morale stemming from major revisions in the rover rules in 1995. Once the scoring methods finally settled down (if they ever have), the rover class began to mature and more fully develop by the late 1990's. The popularity of the rovers is a double plus for the contests, as a rover's activity will cause a large number of contacts to be made with fixed SO and Multi stations, and in a number of different grids.

The most recent category change has been to the single-op class in 2000, with separate categories established for high power and low power SO ops. This has been a very important rules modification, as the SO class comprises the very large bulk of all log entries. The new categories have not been able to stop the problems as to log entries, however, as total SO logs have continued to slide (September) or stabilize (January). Additionally, since the split into two SO classes, there has been an amazing redistribution of stations between the two categories. 55% of all SO stations in the 2000 January event were high power, but since that time, the percentages have slid, to 25% in 2004. Only 168 stations were SOHP in the 2004 January contest while 491 stations enrolled in the SOLP category. This same pattern exists with the two QSO Parties. SOHP comprised 42% of all SO's in 2000, but was down to 26% in 2003 June. September also has similar numbers – SOHP accounted for 32% of the total SO in 2000, but has now eroded to only 26% of all SO stations in 2003. Currently, only 1 in 4 single-ops use high power, and that figure is substantially reduced from close to 1 in 2 just a few years ago in both the January and June events. Thus, it is clear that while the segmentation of the SO class according to power levels has not created a surge of new contesters, it is also very evident that a redistribution of category participants is underway.

As to the microwave bands, microwave activity was noted as far back as the opening days of VHF contesting, with W1OED/1 operating portable on 2400 Mc from Mt. Wachuset, Massachusetts in the 1951 June event. Three sections were worked from that location. (*QST,* August, 1951, p. 1087).

QSO points for the microwave bands were developed in the January VHF SS beginning in 1978, and were adjusted over the years with the VHF QSO Party format. Bigger multi-ops in the 1980's (W1DC/W1FC; W2SZ/1) began to use mobiles to take advantage of these rules, which added significantly to their point totals through coordinated efforts on the microwave bands. By the 1990's, these efforts developed further into captive rover situations, with some rovers making contacts mostly with their own sponsor. Rovers have even occasionally come together to amass dominating positions through grid circling activities using several microwave bands. (2004 January VHF SS, *QST,* August 2004, on-line edition). Club competition scores have even been impacted by the tactic, most notably, in the 1993 January VHF SS when Mt. Airy lost a thirty-year lock on the club gavel because of rover grid circling (See, *QST,* June, 1993, p.107-108, for details).

By early 2003, the concern was expressed that the all-inclusive nature of the three main ARRL VHF contests had degenerated into nothing more than "de facto" microwave events. Many casual and serious operators have become discouraged by the prospect of having non-competitive set-ups due solely to a lack of equipment on 2.3 G and higher

(Zimmerman, 2003). Recently released statistics highlight the situation. Klein (2004) reports that microwave QSO's have exploded in number since 1999 even with fairly level log entries. The Final Report (2004) indicates that in the 2003 September VHF, only 100 stations out of over 500 total logs made microwave contacts, and almost half of those were from multis or rovers. Over 80% of the single-ops did not use microwaves, and over 97% of all contacts took place on 1.2 G or below. A simple use of microwave equipment could however double the score of the few stations that run those bands.

The issue on microwaves may be somewhat geographic in nature. While many areas of the North East have become intensely developed on the microwave bands, most other regions of the country find themselves far behind that pace. The SMC Commentary (2004) concludes that in the Midwest, there is an overall lack of microwave activity, with a desire to actually increase such contacts. Midwest regional and state level statistics bear this out, with band activity in good shape through 1.2 G, but then trailing off sharply by 2.3 G and beyond. Only 13 of the 233 operators submitting a contest log entry in the five state region of the SMC since 2002 have run on 2.3 G or higher, but around 30% have made contacts on 1.2G, and 75% of stations have capabilities at 432. Another interesting tidbit of SMC lore is also illustrative. As recently as the 2004 June, perennial national SOLP winner, Bob, K2DRH, was begging for anyone to join him on 2.3 G for an initial work-out of his new equipment on that band. After several requests, Bob convinced another SMC member, Zack, W9SZ, to haul along his seldom-used 2.3 G equipment to a QRP portable site for one single contact with Bob. A person who is the best in the nation in his class, having to scrounge for microwave contacts in the heart of the SMC!

It is therefore evident that an impact is certainly occurring from the current microwave scoring rules, but it is far less evident whether the impact is good or bad. It largely turns on one's perspective of whether microwaves are generally underused or badly overextended. And that belief is chiefly dependent upon whether you have witnessed and experienced abuses on these bands or whether you dream of someone showing up in your neck of the woods with micro equipment of even a marginal nature.

Conclusion as to the Rules regime. Just as the general issue of causative effects to the VHF contests is multi-faceted in nature, so too is the topic in the area of rules revisions. In some instances (QRP), the little evidence of an impact is actually one of national trends impacting the newly created category, instead of an impact occurring upon log entries from the new category. In other instances, revisions have had both positive and negative impacts upon contest activity (rovers in 1991, 1993, 1995). With some changes however, (grid squares in 1983), there has been a universal fondness for the change, but without evidence of a log entry enhancement. Additionally, with contentious issues (rovers, microwaves), the observed effects on the contests are subject to various interpretations. As such, the effects on log entries, point production, and overall participation levels in the VHF contests from rules related factors are mixed, at best. The law of unintended consequences comes into play, too, with rules revisions that are thought to be necessary to correct inequities in contest activity (rovers, 1991, 1993) ending up causing so much furor in other areas (club competition in 1993) that activity levels among many contest veterans possibly dipped for a time. Even with rules revisions

expressly designed to increase activity through a leveling of the playing field (limited; SOLP), the total contest log entry count has not been greatly affected. Instead, the high power category of the SOHP is undergoing a mass exodus to its low power counterpart. It is doubtful whether the designers of this new category intended such an impact.

Rather than attempting a rules revision in the name of band activity and log entry improvement, the evidence suggests that rules should chiefly and simply provide a basic and consistent framework for contest enthusiasts to operate within. As previously noted in SMC Commentary (2004), tinkering with the rules in an effort to increase log activity may or may not ultimately work. And if rules changes do work to increase entries, they may not work out as envisioned, causing unintentional problems in other directions. The category revisions have certainly enhanced the variety of the contests, and adoption of grid squares has been tremendously popular. And that's where the rules regime can make a large and positive impact on contesting, in the enhancement of the qualitative experiences and preferences of the contestants.

10-04 update, as to Rules regime: In the 1961 log entry peak, the January VHF SS was considered the only major contest, with the two QSO Parties being almost an after thought. Everything revolved around the clubs in one VHF contest. The focus of the event was on SO's having 6 and 2 meter stations capable of making contacts (not qso points) into other states. Compare that with current time frames, with three majors, 6 total contests, 3 separate club categories, 6 different operator categories, and a scoring system based grid squares, band multipliers, and QSO points. The current system is mature, rich, and diverse in tone and set-up, especially when compared to the contests of yesterday having almost a one-dimensional nature. I note that in the 1975 low, there were only 1000 total logs in three contests; at the 2002 low, there were over 2,000 logs in the big three contests, and over 2400 logs over 6 contests. Comparing the two low marks of the contesting cycles, the varied format of today enjoys far greater popularity than that of yesterday.

10-04 update, as to scoring changes: There is little or no statistical evidence linking changes in microwave scoring methods to log entry changes, but there is ample evidence showing that the microwave scoring modifications dramatically increase total contest points. Within two years after adding QSO points to the January VHF SS, point totals increased by over 50% in the club competition. Then, with the adoption of grid squares as the multiplier in 1983 instead of ARRL sections, scoring took another major jump. By 1989, the club competition garnered more than 6 Million points. Before the grid and microwave changes occurred (circa 1977), the club competition hovered somewhere below 2 million points. While there have been no major changes to log entries from scoring changes, there have been major impacts to the scoring methodology of the contests, and the way in which operators vie for points. The basic nature of the VHF contests is remarkably different today than it was in an era where contacts could only count once, as in the HF SS, and where sections were used for multipliers. This represents a major qualitative enhancement in the contests. It may have also generated an overall increase in log entries that is too complex to easily quantify, as implied by the

large increase in total logs across all contests from the mid 1970's when contacts regardless of band were the priority of the day.

National sponsorship of contests – 9-2005 update. Numerous VHF contests have come and gone over the years. The events that have stayed have been the ones having significant sponsorship by an organization with a national reach. The ARRL and CQ sponsored have generally enjoyed a great deal of activity, but many other VHF contests have attracted much smaller activity levels. Examples include: The Space VHF contest that was sponsored by either one person or a small club for several years in the 1960's; the 2 GHz and Up event, sponsored by SBMS in 2005; the NA Spring MS Rally, recently sponsored by the WSJT group, and contests run by SMIRK and SWOT. These contests have all filled a niche in VHF activities, but do not have a great and large following throughout the nation. Even the Sprints are a case in point. Originally sponsored by eth League in 1983 to encourage the usage of the newly adopted grid squares, the Sprints were very popular initially, but then gradually decreased in activity levels. Eventually, the League moved responsibilities over to their contest magazine, the NCJ. ARRL sponsored was cancelled entirely in 1999,due to lack of participation (CQ, 2-99, at 5). The Sprints was then adopted by various regional level clubs and VHF societies (CQ VHF, 4-99, at 65), but with little activity to them.

In addition to the necessity of having widespread support for the contests, the support must be consistent. CQ's VHF column has been a driving force for many years behind the CQ VHF contest. But whenever that column faltered or the column writer became busy on other matters, the VHF contest also suffered. The sponsorship of the contest needs to be methodical and consistent in order to be effective. Otherwise, log entries will begin to fall as a result of sporadic or intermittent publicity given to a VHF contest.

The Solar Cycle. Some people believe in a relationship between the solar cycle and log entries and / or operating activity. Considering that we have seen six full 11 year solar cycles since 1948, but only two large peaks in VHF contesting, the belief is rather ill-founded, at least upon a cursory glance of the issue. The first increase in log entries, leading up to the 1961 contesting peak, generally occurred during a solar cycle advance, although the actual peak in logs took place two years past the solar cycle peak, when the solar sunspot numbers were already in marked and rapid decline. During the long decline in log entries from 1961 to the 1975 low point in January VHF log submissions, the next solar cycle fully occurred, meaning that sunspots went from a minimum, to a solar peak, and then once again declined while the January log submissions continued their decline unabated. The actual low of log entries in 1975 generally coincided with a sunspot minimum, however. During the gradual resumption in log entries to more stable levels of the late 1980's, two more solar cycles transpired. Most significantly, the second log entry peak in the mid 1990's actually occurred during a period of solar sunspot minimum. A stabilization / gradual decline in log submission has now been going on since 2000 even though the sunspot numbers have once again been in rapid decline. Obviously, the 11 year solar cycle does affect general band activity and operating conditions in various fashions, but there is little evidence that contest log entries consistently follow solar cycle patterns.

To quantify this conclusion, I took NASA solar sunspot number (SSN) data and statistically compared it to log entries in the January VHF SS. Excel's data analysis package was used for this effort. The period of comparison ran the full length of VHF contesting, from 1948 through 2004. I used the mean average SSN for the month of January for each year, and ran both correlation and regression analysis on the two sets of data. The correlation coefficient showed no statistical relationship between sunspot activity and contest activity. The movements in the two data sets were statistically independent of each other over the length of the contesting era. The regression analysis shows much the same, with a complete lack of explanatory power between x and y variables. A scatter gram was also run, and this showed a wide visual dispersion in the data, which is quite consistent with the statistical output.

Perhaps the matter is more complex than a simple one-on-one comparison between an x and y variable, with so many other factors and impacts occurring in a simultaneous fashion. While no statistical correlation exists between solar activity and log entries, it is still rather interesting that the 1961 log entry peak, the first part of the log entry decline after 1961, and the last part of the log decline in 1975 all generally coincided with either a solar cycle max (in 1959), or consecutive solar minimums (1964, 1976). It can at least be argued that a solar advance or decline can amplify a dominant trend in VHF contesting that is already underway (the Novice and Tech explosion in the late 1950's; the changing modes of communication and the loss of Novice VHF privileges in the early to mid 1970's), but then has little or no impact on contesting numbers in the absence of a clear trend in VHF activity levels.

Generating statistical output on partial periods, such as 1955 to 1965 when both solar activity and log entries were rising and then falling within a few years of each other, might even produce something of a statistical relationship. There would then be a question, however, of data mining using carefully selected periods to deliberately end up with statistically significant results. There is also a concern that some people may be just imputing a solar cycle cause to the log numbers that was not being contemporaneously expressed and felt at the time. Writers certainly knew about the solar cycle back in the 1950's, but articles in that era directly attributed the increase in contest activity to the Novice and Tech explosion as well as to newer radios and technology then developing (Tilton, 1959, 1960). There was little or no discussion given to solar numbers driving contest participation levels. It was only years later that *QST* contest write-ups (the Jan. 1976 VHF SS, for instance) mentioned the solar cycle of the 1950's as a causative factor in the long-standing nature of some 1950 era contest records.

10-04 update: Simple linear regression analysis that I have recently done on partial solar periods shows a strong relationship between log entries and solar activity in the 1950's and 1970's. I am still concerned about data mining problems, by developing math equations with a specific set of known data points in mind.

Local Weather, Propagation, and Band Conditions. Contest reports are replete with variations in local weather and band conditions. One area of the country will be

inundated with snow in the January VHF SS, for instance, while another area will be quite balmy. Or, a strong tropo, aurora, or E skip will occur in selected areas while other regions will be boringly quiet. Local variations in weather or band conditions do occur quite frequently, and they have become accepted as being "part of the show", actually lending themselves to the general flavor and make-up of the VHF contesting experience. Two types of impacts related to weather and propagation probably occur in the contests.

First, there is a definite, yearly cycle of band activity and propagation characteristics, revolving around the ebbs and flows of seasonal weather and band patterns. The January VHF SS is renowned for its flat band conditions. Even a small Es opening in January is considered a real treat. That's why the club competition is the primary, driving force in January – there's little else of interest in many VHF SS's. The June VHF QSO Party is marked by frequent Es openings on 6 meters (that are not necessarily related to the 11 year sunspot cycle), and such openings can extend to 2 meters upon occasion. June also is a great time for enhanced tropo conditions on the upper VHF bands of 2 meters and above. September is noted for its aurora activity, and some aurora events have been so intense that contest write-ups will speak of little else.

Harker (2004) has produced some wonderful contesting maps, showing contest stations plotted on a map of the US from known lat / long coordinates of participating stations. Harker visually and quite clearly shows that the January and September VHF contests are dominated by the North East Corridor and Midwest, while 6 meter activity is the "great equalizer" in the June event, with top ten scores scattered throughout the nation. Thus, the variations between the contests in any one year may be partly explained by propagation typically frequenting the events.

Secondly, specific contests with great band openings can affect participation and log entry levels. Certain contests have such strong openings that they are talked about for many years afterwards. Some, but not all, of these contests have experienced higher than expected log entry submissions. For example, the 2003 June QSO Party had amazing nation-wide 6 meter band openings, resulting in much higher log entries than the year before. The 1998 June also experienced strong, two-day Es openings, and numerous division records were broken that year. Log entries were up compared to the year before and after. The 1987 June had huge Es clouds, and log counts were also up versus the year before and after. The 1986 September had big tropo into the south and Midwest, and log numbers were up somewhat compared with prior and subsequent years. Conversely, the 2001 September enjoyed a big east coast tropo, but the numbers on that contest were quite consistent with a continued slide in log entries. The 1998 September witnessed a massive Midwestern opening, but log entry numbers were way down versus 1997 and were almost the same as 1999.

In summary of this section, the weather, seasonal band activity, and major band openings in specific contests can certainly affect the style and amount of station participation. But, neither the yearly, seasonal pattern nor an impact from a massive band opening can account for the large swings to all contests across all years.

Moral Persuasion. There does appear to be a temporary impact of a positive nature from the simple threat of contest revisions. After the League let it be plainly known in early 2003 that the VHF contest format might be changed in significant ways, many amateurs were initially stunned. Once they recovered from the thought of a drastic revision in the rules, many people set out to do something about the matter. Both clubs and individuals began more ardent efforts at contest activity. By the June QSO Party of 2003, numerous operating positions had been activated or strengthened. Coupled with tremendous band conditions, log entries rose by over 140 participants, from 672 entries just the year before up to 818 entries in 2003. The totals eclipse all prior June contests since 1998, when a huge band opening generated enormous band activity on 6 meters. Indeed, the 2003 June totals were so large that they actually eclipsed the January VHF SS numbers generated a few months before, and that possibly has never occurred before for either June or September events (although the historical data for the VHF QSO Parties is incomplete). By September 2003 however, the ability to increase contest activity through moral persuasion and reasonable discussions had evidently worn off, with the September totals continuing its gradual decline. But then, the 2004 January VHF SS saw good, solid numbers with a small increase in log activity. The June 2004 contest experienced weak band conditions, and it is expected that log entries may be lower, as a result.

Through much of the summer, 2004, the possibility of a complete elimination of the August UHF was still very real. Many operators from around the country turned out for this event, if only to be part of the "last one". One club, The Northern Lights Radio Society gathered their forces *en masse*, with over a dozen rovers and a large number of fixed stations being activated for the event. Activity levels were so elevated in the upper Midwest that one well-known amateur in Iowa even expressed frustration at having to juggle so many rover schedules and liaison frequencies (VHF contester reflector correspondence, 2004). Now, that's a turn-out.

Motivation of complacent masses into action may sometimes occur through the mere concern over rules changes. The effect may be only temporary however, as things return to lower band and contest activity once the perceived threat passes. It is not something that should be made part of a permanent plan to increase participation levels.

Contest Administration. Various administrative issues arise form time to time, and the possible effects upon participation levels should be reviewed.

Starting in 1997, the League began building its web-site into a repository of information on amateur radio activities and contesting. Contest rules and articles from *QST* on contest results were posted on the web-site. An electronic log submission ability via the web-site was gradually developed using a computer format known as Cabrillo. Contest rules were then reduced to a summary format in *QST,* with a full description available on-line. An interactive data base feature was added for the contests in 2002 and beyond which allowed ARRL members to download, sort, and calculate data from the contest results. A technical information and reference service on numerous areas of amateur radio, including VHF and UHF matters, made its appearance on-line. Starting in 2002, the League moved the contest result line-scores to an exclusive on-line presentation,

eliminating the line scores from *QST*. The number of pages in *QST* devoted to contest results declined in a cost savings move, but regular columns were then added on microwaves, satellites, and other VHF related matters, while many extra *QST* articles and special features began appearing on many VHF topics. Web based applets were developed beginning 2003, which allowed for easier electronic submission of log entries of smaller logs. The Log of the World computer program made its debut, also in 2003.

Reviewing the log entry data on all three main ARRL contests with these above listed activities, there is little or no evidence that any of the changes and innovations have affected contest log entries in a material way. (Final Report, 2004). The period from 2000 forward has been marked by stagnation in scores in the January VHF SS and the June VHF, and a gradual reduction in log entries scores in the September VHF. There has been no large and sudden change in contest submissions (with the exception of the 2003 June VHF, which was likely the combined result of moral persuasion, excellent band conditions, and the first year of the club competition). The Final Report (2004) admitted that start-up issues regarding contest logging did occur, but they "happened years after the decline in entries began".

The matters relating to contest administration may be more qualitative in nature than quantitative. I submit that start-up issues occurred not only with contest logging, but with many of the other administrative changes, as well, especially the line-score deletion from *QST* and reduced print coverage to contest reporting. People are still grumbling over the loss of the line-scores from print, even though the line-scores are readily available in the on-line version of the contest write-ups. Those same people are still participating in the contests. So, the start-up problems on administrative changes have been more related to quality considerations than to quantifiable and adverse hits to log entries.

Some of the changes have actually been positive, from a qualitative point of view. For instance, there has been widespread approval of both the interactive data base features and the LOTW program introduced by the League. The logging robot has even been given grudging acceptance by many contesters as speeding up the log submission process.

In general, the adverse effects upon log entries have been minimal (if at all). We may even see a positive impact going forward as people become used to and actually expect electronic-based technology and information. The qualitative concern may still be with us for a while until people adjust to newer on-line information delivery techniques, instead of having an exclusive reliance upon the print medium. The on-line changes made by the League may eventually be viewed as expanding the information related abilities for contesters.

9-2005 update: a working paper for the CQ VHF contest (publication pending, 2005), goes into detail on the differences in contest administration between the ARRL and CQ. The differences in administrative styles between the two organizations illustrate the differences in contest structures. The CQ administration has been innovative, but rather chaotic in nature. The ARRL administration has been methodical and systematic, but

rules changes have been difficult to produce. There may be a possible symbiosis between the two administrations, with CQ trying out new ideas, and ARRL incorporating the more successful thoughts.

Club Activity. 10-04 update: I have now written an extensive article on the role that VHF clubs play in contest activity, with my most recent data and regressions being discussed in the article. It was published in *Cheese Bits* in January, 2005 as "The Role of the Clubs", and is also available at the SMC web-site, Dec. 2004 issue of the SMC *Black Hole.* The article shows that clubs have had a huge impact upon VHF contesting over the years, but that the percentage of club logs to total contest log entries has been declining as individuals increasingly have greater operating options outside of a traditional club format. Additionally, the clubs have been greatly affected by regulatory changes, just as overall contesting activity has been affected.

The Shifting Modes of Communication, 11-04 Update. Several correspondents have suggested to me that the interplay between various modes of communication on VHF may have played a part in the decline in log entries in the 1970's.

FM experiments occurred on 2 meters as early as 1948 (12-54 *QST*, at 69). SSB contacts on 6 meters were initially made in 1951 by W1PNB and others (1-51 *QST*, at 43; 5-52 *QST*, at 43). But CW and AM were the preeminent modes of communication on VHF throughout the post WWII period. Beginning in the mid 1960's, SSB began to supplant AM on HF, as technology had advanced to the point where phase modulation problems were becoming more manageable. SSB was more prone to phasing distortion difficulties on VHF, but by the late 1960's, VHF equipment had become available that adequately dealt with these problems. AM then quickly lost it dominance on VHF, and all of the equipment made from that time period forward contained SSB and CW modes. Contest reports and soapboxes during this era noted the declining activity on AM (Sept 1975 contest results, for example).

Meanwhile, the widespread development of FM repeaters in the 1970's made FM the primary means of casual, local communication on 2 meters. The increasing FM activity was noticed by VHF contesters, and several strategies were devised to take advantage of FM simplex contacts. Some of the stronger stations dominated local FM simplex frequencies, due to the capture effect inherent with the FM mode. By June, 1976, contest rules began to restrict the usage of the FM simplex frequencies. After a long and robust debate as well as a series of rules revisions, the 2 meter FM simplex calling frequency and adjacent guard channels were completely prohibited for contest work in June, 1982. At the same time however, a prohibition on the 223.50 FM simplex frequency was lifted.

Much of the popularity with FM came from new licensees, drawn to the latest technological offering. FM was also popular with local amateurs that had desirous of reliable local communications. FM repeaters made these local contacts much easier to accomplish.

More currently, VHF packet work became very popular in the early 1990's as technological advances made BBS and node activity an everyday occurrence. Packet rapidly declined however by the late 1990's, with the arrival of the Internet into residential settings. Most currently, the new digital modes of JT44, et al, are dramatically improving EME and meteor scatter communication abilities.

How have the changing modes of communication affected contest activity? It is difficult if not impossible to quantify the impact, due to a lack of statistical data on the various modes used during the contests. The only written sources of available information on the matter are the comments found in the contest write-ups, contest soapboxes, and the *World Above 50 MC* column, and these are necessarily limited and subjective in nature. Personal observations of contesters active during the various time frames involved may be the best information, but a collection of thoughts from such people would be difficult to do in a methodical manner, and also would be necessarily subjective in nature. Additionally, the personal remembrances would be flavored with the tint of history and yesteryear, as they would not be based on contemporaneous musings.

Aside from these difficulties, it might still be possible to make some general observations.

First, changes in the mode of communication, *per se,* may not have generated any significant gain or loss to contesting activity. People just switched to the other modes of communication, and continued their contesting ways. We are seeing that now, with JT44 being readily accepted as part of the contesting environment. Contesters simply adapt to the changes in technology.

Second, the advancements in technology that introduce new modes of communication apart from contesting may have contributed to a temporary net loss in VHF contesting. For example, both the popularity of FM in the 1970's and the rise of packet activity in the early to mid 1990's may have bled off some of the "newer blood" from weak signal work and towards these newer technologies. The mid 1970's lows in contest log entries would be consistent with the development and immense popularity of FM repeaters as an alternative form of activity away from contesting. As to packet, the development of packet activity initially occurred during the influx of no-code technicians into the hobby. So statistically, any adverse impact on contesting from the rise of packet would have been swamped by the tremendously positive effects on log entries from the Technician influx. The rise of the Internet in the mid to late 1990's is consistent with the downturn in contest log activity at the time. More currently, however, contesters have adapted to the Internet quite nicely. People may gradually return to contesting after the introduction of the alternative technology, and may even use that technology to their ultimate benefit in the contests.

Third, it is doubtful that the FM rules changes chased away or brought in many contesters. The use of FM simplex was considered to be a problem in certain urban areas where the bigger stations could take advantage of the situation. The changes merely ended that scoring advantage by the urban kilowatt stations. The FM rules may have

taken care of a perceived inequity occurring at the time. But, the imposition of the FM rules changes seems to not have had a sizable impact on contest participation.

In conclusion to this addendum, the changing modes of VHF communication are part of the broader technological and demographic forces at work on the VHF contests. Whenever a new competing technology opens up with mass appeal and popularity, (such as FM in the 1970's; Internet in the late 1990's) contesting activity may take a dip for a time as people wander off to explore those new activities, or simply never develop an interest in weak-signal work to begin with because of interest in the alternative technology. Over a longer time horizon, however, contesters simply adapt to the new technology, incorporating it into their contest endeavors.

Note: I especially thank Curt Roseman, K9AKS; Jim Roseman, W9UD; and Gene Zimmerman, W3ZZ, who provided me with their thoughts and recollections for this section on mode conflicts.

9-2005 update: AM activity nets in the 1950's and 1960's were extraordinarily popular. In fact, if a person was on VHF in those days, he was on a weekly AM activity net that was sponsored by a local club. Local communications on VHF revolved around these nets, in fact. The club oriented VHF contests provided the perfect opportunity for amateurs to test out their lunchboxes and Gonsets. It should therefore come as no surprise that the January VHF SS was the preeminent event on VHF, while the other contests struggled for attention.

All that changed once AM came to be supplanted by SSB on VHF in the 1960's and then by FM repeaters in the 1970's. SSB opened the way for more sophisticated equipment capable of going longer distances. The focus shifted to the individual capabilities of VHF stations as communicating over vast distances, as opposed to a steady ability to communicate across a town. The vast surge in new amateurs hitting VHF AM who wanted to talk to their friends a few miles away gave way to a more singular approach in VHF communications. The era of AM on VHF was over, and with it, came a decline in VHF contest log entries, especially in the January VHF SS. FM repeaters allowed hams to then reform their nets and local communication needs around the FM mode. Such activities were not overly conducive contesting. The lull of VHF contesting activities into the 1970's therefore becomes readily explaining, as the VHF amateurs had become a much more diffuse population, using any number of modes on VHF.

The popularity of AM in the late 1950's / early 1960's and the shifting and diffusing of VHF modes of communication thus goes a long on in explaining why such a comparatively small US amateur population in 1961 could generate a record shattering 1563 logs entries in the 1961 Jan VHF SS, a record that is still standing to this day with an amateur population many times larger. It also serves to explain why the June and September VHF QSO Parties grew in popularity form the mid 1970's forward. With interstate communication on 2 meters and true DX work on 6 meters now a very real possibility and objective of many amateurs, the summer contests catering to individuals grew comparatively more popular. The log entry numbers of the club-led contests held in

the dead of winter and having no chance of propagation started to trend closer to that of the individual-oriented tests held during the high point of the propagation season.

2005 Note on Demographic Factors. In addition to the "loss of interest" factor that helps explain the fall from the 1961 and 1996 peaks (see Part II, for more details on loss of interest), other demographic factors may also be involved. This is an area that has not been extensively analyzed, but certainly deserves attention. An aging amateur population, especially among VHF enthusiasts, may have had the effect of lowered contest log entries and / or reduced the competitive levels of those that do submit entries. After having participated in numerous contests, the older amateurs may simply not be driven as in years past when the contests were "new and fresh". With fewer younger and newer amateurs to revitalize contesting, the argument is that the log entries have gradually slid. Also related to demographics is the fact that many amateurs in urban areas are having an increasingly difficult time with finding sufficient room or having enough economic resources to build great antenna systems. (Zimmerman, 2005). I refer to Zimmerman's demographic thoughts as an "age-wave", since we have continued activity from people that are getting older but then no activity coming from newer / younger people.

Regulatory changes, 11-04 updates. While the focus of this paper is on the "Other Impacts", the most recent data and information that I have compiled is generating some very interesting statistical results on regulatory activities that I want to address here.

1-05 Update: I have now added comments on additional authorizations to Technicians in 1972, 1975, and 1987.

The regulatory change in 1951 allowing access by Novices to 2 meters generated a huge and immediate impact on 2 meter band activity. Within 6 months of this regulatory authorization, contest write-ups were commenting that Novice participation was "an important factor in the larger 2 meter scores this year" (*QST,* 3-52, at 60; note on January VHF SS, 1952). Within a year of the Novice authorization, contest activity was considered to be "at an all time high in many quarters, particularly in areas where extensive 2 meter activity concentrations encourage participation by Novices" (*QST,* 9-52, at 52; notes on June, 1952 contest). Within 4 years of Novice authorization on 2 meters, contest log data showed that 2 meter band activity had increased by over 100%, from 290 stations with 2 meter contacts in the 1951 January VHF SS (the last January contest before Novice authorization) to 705 stations having 2 meter capability in the 1955 January VHF SS (Tilton, 1959, 1960).

At the same time that Novices were granted access to 2 meters, the Technician license was initially developed. Technicians were required to pass a 5 wpm cw test, and also pass some or all of the same written exam elements as the General license. Many Novices were able to pass the written elements but not the 13 wpm code requirement of the General license, and thus, they obtained a Technician license as an interim step. Rules at that time allowed concurrent holding of Novice and Technician licenses. This was important to many amateurs, as Novice licenses lasted only one year and were nonrenewable, unlike Tech and above licenses that were renewable. However,

Technicians during this time frame were given privileges to only 220 Mc and above. The *World Above 50 Mc* column indicated that 220 and 420 activity increased marginally with the new Technician license (Tilton, 1-53 *QST*, at 54). But the pick-up in band activity was hampered by the lack available equipment on those bands as well as by many Technicians feeling the license was largely transitional in nature (Tilton, 6-55 *QST*, at 71). Contest log entry data confirms the limited impact: Some 4 years after the development of the Technician authorization for 220 and above, only 4.1% of all operators in the 1955 January VHF SS used 220 Mc, and only 1.9% of all stations used 420 Mc. This is opposed to 94.4% of all stations running on 2 meters in the same contest.

Technician operating privileges were expanded to 6 meters, effective April 12, 1955. This had a dramatic and immediate impact on contest activity. Just two months after 6 meter access by Technicians, the June VHF QSO Party of 1955 experienced a 60% increase in operators on 6 meters (Tilton, *QST,* 9-55, at 57). 6 meter activity surged in the years ahead. The last January VHF SS before the Technician 6 meter regulatory change (1955) had only 90 stations active on 6 meters. By a few short years later in 1960, that number had increased to an astonishing 1,160 stations. No longer was the Technician license a mere transitional point to the higher-grade licenses – Technicians could now enjoy definite operating activities in their own right. The 6 Meter Technician operating privileges granted in 1955 may have thus generated the single largest impact ever felt upon the 55 plus years of VHF contesting history.

Technician access to parts of the 2 meter band occurred in the summer of 1959. Station activity jumped from 590 log entries on 2 meters in the 1959 January VHF SS to 950 stations the very next year. When the combined effect of Novice access to 2 meters in 1951 and Technician access in 1959 is considered, 2 meter band activity in the January event climbed over 220% in 9 years.

In terms of a connection between band activity and log entries, the 1957 contest write-up (*QST,* 4-57, at 49-50) took notice of the 6 and 2 meter band activity increases occurring since the early 1950's, and Tilton (1959, 1960) directly attributed the increases in band activity and log entries to the new–found operating privileges of Novices and Technicians. Recently conducted statistical analysis confirms the relationship. 6 and 2 meter band activity has almost a complete correlation to contest log entries (.967 for 6 meters; .892 for 2 meters during the 1952 to 1962 time period). Simple regression analysis shows much the same, with statistically significant explanatory results between total contest logs entries and 6 and 2 meter band activity.

An exclusive cw subband on 6 and 2 meters was authorized in 1960, at the urging of the League. Contest write-ups and soapboxes repeatedly referred to a heightened ability at obtaining new section multipliers and contacts as a result of cw usage. There is little mention whether any new stations actually entered the fray as a result of the cw subband. It is even difficult to determine whether 6 meter band usage increased after the cw subband was developed, due to the increased usage of 6 meters following the 1955 technician authorization.

Contest log entries for all three VHF contests peaked in the early 1960's (September, 1960; January 1961; and June 1962), and declined from that point. Interestingly, no adverse regulatory changes occurred until several years later. For instance, the January VHF SS had a net loss of 438 log entries between the 1961 peak through 1967, representing a decline of 28%. The June contest also experienced a 28% loss in log entries in the same time frame, and September had a 28% net loss in logs. It is thought that the decline is largely due to licensing upgrades by Novices and Technicians and by a gradual loss of interest among many of the newly minted contest participants. We will see this effect occur again in the 1990's, both in the US and abroad.

In 1963, the power limit on 432 Mc increased from 50 watts to 1 KW. This change in transmission power did not initially generate new operating activity (9-63 *QST,* at 72), and did not increase contest activity on 420. For example, some seven years after the power limits were lifted, 220 still had more entries than 420 during the 1970 January VHF SS.

The power limit increase may have contributed to the advancement of moonbounce work on 432, however. Early amateur efforts at EME in the 1950's took place at 144 Mc (see, article on Project Moonbounce, 3-53 *QST;* and also, Tilton, 4-53), but antenna sizing limitations and ambient temperatures proved to be so difficult at 2 meters that moonbounce attempts shifted to 1296 Mc. Seven years later in 1960, the first two-way amateur moonbounce contact occurred using 1296 Mc (9-60, *QST*; The US military, and possibly the Collins Radio Company and / or EIMAC in conjunction with the military, had successfully completed moonbounce contacts between Maryland and Hawaii earlier in the 1950's). Meanwhile, real EME efforts commenced on 432 after the power levels were increased. The first successful 432 Mc EME QSO occurred in May, 1964 using full legal power limits at the Arecibo 1000 foot reflector in Puerto Rico. In July, 1965, EME tests were conducted from Arecibo exclusively using 432, as interest lagged for 144 and 1296 moonbounce contacts (QST, World Above column, August or September, 1965). Today, 432 is a favorite for moonbouncers, as high power levels can be more easily obtained than at 1296. Contesting activities may not have increased as a result of this rule change, but 432 EME work became practical as a result of the power increases.

In 1968, Novices were prohibited from using voice modes on 2 meters, and Technicians were restricted from the cw frequencies on 6 meters. On 11-22-72, Novices lost all use of 2 meters. CQ, 10-83, at 58, column on Novices, felt that the 1972 elimination of 2 meters had almost no effect on Novice operation, as the 1968 Novice phone prohibitions restrictions had already caused Novices to effectively cease using the band.

Novices gained access to 10 Meter band on same date they lost 2 meter cw privileges, on 11-22-72. Also, Technicians received 145-147 MHz, and then 147-148 in 1972, and their authorization expanded down to 144.5 in 1975.

While it is difficult if not impossible to separate the effects of the above noted gradual loss of interest from adverse impacts of these regulatory changes, it is commonly felt that

the restrictions in operating privileges contributed greatly to the continued decline in contest log entries. One of the contest write-ups and soapboxes from 1968 expressed the concern that the loss of Technician cw authorization eliminated the most effective form of DX communication available to many amateurs, and stated the fear that the loss of the cw segment for Techs may have reduced contest activity. The loss of phone privileges for the Novices in 1968 was very likely a major factor in decreased 2 meter contesting activity, thereafter. Further, 10 Meter Novice authorization at the same time of complete Novice prohibition on 2 meters in 1972 may have had a lasting effect of completely moving Novices away from VHF and moving them back to HF band usage.

The January VHF SS bottomed out at 573 logs in 1975, some 49% less than the year before the operating restrictions went into effect. The June event hit a low in 1973, with a further loss of 15% in logs. September's low occurred in 1976, some 36% lower than before the restrictions. In all, January was the hardest hit of the contests, with a net loss in log entries of 988 logs between the 1961 peak to the 1975 low. Total logs entries were only one-third of what they had been at the peak. The restriction in operating privileges in 1968 and 1972 may have very well been large factors in the continued downtrend in all three VHF contests.

There is a lack of historical evidence on Technicians gaining some more complete access to the 2 meter band in 1972 and 1975. Contest band activity shows that 2 Meters became more heavily used than 6 meters by 1975, and this was a change from the early days of VHF contesting of 1958 forward when 6 meters was the lead band in the contests. But the two bands were very closely aligned in terms of usage, with 77% of all contestants using 6 meters in 1970, versus 72.8% using 2 meters. By 1975, 77% were still using 6 meters, but 88% were now using 2 meters. So, partial access by Technicians to 2 meters in the 1970's might have made 2 meters more popular. But the granting of privileges at that time did absolutely nothing to stop the massive slide in overall contest log activity to all three of the VHF contests. Overall, Technician access to 2 meters seems to have helped 2 meter contest activity, but neither 6 or 2 Meters access had any substantial impact on total contest log activity.

Log entries slowly advanced from the mid 1970's low water marks. As discussed in the main section of this paper, the increase in logs and contest activity was possibly due to due to 1) modernization of the rules set; 2) technological advancements then occurring; and 3) a gradual resumption of interest in VHF weak signal work and contesting after the FM craze wore off.

Novice designated call sign issuance was eliminated in 1976, making the WN prefix a thing of the past. By 1978 (possibly 1976?), Novices were granted renewable rights, initially at 2 years, but eventually expanded to 5 years. Most importantly, Novices were now allowed usage of VFO control and power limits were increased to 250 watts. These changes, along with the Tech changes noted below, have been credited with spurring growth in US operator numbers for the next 10 years. CQ, 3-2000, at 6.

Another regulatory change has been noted in this time period (Zimmerman, 2005 e-mail correspondence). In 1978, Technicians regained full access to the CW portions of the VHF bands. Coupled with partial authorization on 2 meters earlier in the 1970's, the full reentry of Techs on 6 and 2 meters provides yet another explanation for the gradual resumption of contest activity starting in the mid-1970's. It becomes a question as to what factors constitute the "gradual" variable. In addition to the three above noted items, "4) Technician reauthorization and Novice restructuring" is certainly feasible. Indeed, each of these items could have been partly responsible for the 15-year long advance in contesting activity from 1975 to 1990. I suspect they all were involved, as there was no single event or factor that has stood out in either the historical record or the statistical data. The lack of specific identification as to the variable "gradual" aptly demonstrates the complex mix of factors involved. The gradual increase in contest activity is actually more interesting than the two log entry spikes in 1961 and 1996, since the peaks were not self-sustaining, whereas the gradual increase in contest log submissions from 1975 was definitely sustained until 1991 when the no-Techs flooded the bands *en masse*. Further exploration of the multiple factors that lay behind "gradual" is therefore warranted, and is highly recommended. This is precisely the kind of log increase that we should strive for, in fact.

Yet another reason for the 1970's expansion of VHF activity could have been related, ironically, to the CB craze in the 1970's. One commentator (Frederick Maia, W5YI, CQ, 4-88, at 88-89), traced the 1970's boom in the number of US amateur licensees to the boom in CB activity. So long as CB was growing in the 1970's and early 1980's, a steady pool of radio enthusiasts existed from the CB ranks, who ultimately moved onto amateur radio. The growth rates of US amateur numbers closely paralleled the rise and fall of the CB radio Service of that era (Id, at 89). When the CB craze wore off, so did a high growth rate of the US amateur population. Some of the growth of the overall US amateur population wound up in VHF contesting activities, increasing VHF numbers by the late 1970's, so goes the argument. But others (Frenaye, 2005) have felt that as the CB boom became a bust by the late 1970's, many CB'rs found their way to the amateur ranks so that they could keep up their technological interests. Frenaye (2005) noted that the CB boom and bust may have boosted ham radio's ranks in the 1970's by almost 100,000 amateurs.

Incentive licensing starting in 1967 and 1968 has also been attributable to the increase in US licensee numbers. Over a 20 year period to the 1980's, at least one article has suggested that the positive effect on US licensee upgrades and general activity increase was considerable. CQ, 5-85 at 105 attributed the increase in Extra and Advanced licenses to the incentive licensing structure implemented in 1967 and 1968, with corresponding reductions in General licenses through upgrades. Ultimately, some of the license upgrades found their way to the VHF bands, and then to VHF contesting.

Technicians received access to 10 Meters in 1987. This should have produced a drag on the VHF contests, as Technicians suddenly had great opportunities on the HF bands. Instead, there was almost no effect on overall contest log submissions from 1987 through 1990. A total of 1917 logs were entered in the big three contests in 1987. Some three

years later in 1990, there were 2010 log entries for the three contests. If anything, contest activity marginally improved for three years after 10 Meter access was granted to Technicians.

No changes in the licensing structure occurred between the late 1970's and the early 1990's. Then in February, 1991, the FCC undertook a huge regulatory change when the no-code Technician license was developed, with a 10 year renewable license authorization. The existing Technicians with their 5 wpm cw requirement were unaffected in their operating privileges, but the new no-code Technicians were allowed access on all VHF frequencies. Almost immediately, the number of Technician licenses exploded. Within a year, the Technician class expanded by 21%. Over the next decade, the Technician ranks increased by over 100%, from 158,000 before the regulatory change, to almost 336,000. Interestingly, many no-code Tech licenses were not renewed at the 10 year mark, and current figures as of January, 2004 show a net decline to 322,000 Technician licenses. Contest log entries swelled from 1991 through 1996, and it is generally believed that this 2nd peak of contest activity (January peaked in 1996 at 1,250 logs; June in 1996 at 923; September in 1997, at 752) is largely the result of the no-code Technician regulatory change (as well as the further development of compact multi-band VHF transceivers in the early 1990's, ala IC-706).

No regulatory changes occurred for some four years after the 1996 peak. Contest log entries then declined for all three contests even though the number of Technician license holders continued to increase until 2000. This is the same pattern as was seen in the 1961 peak, and is consistent with the thesis that license upgrades and a general loss of interest by the new license holders are responsible for declining log entries after a major contesting peak stemming from a new licensing structure. Also of note is that the no-code licenses in Japan display a very similar peak, with a quick rise and fall of no-code technician license holders (taken from Speroni Excel data, 2004). Regulatory changes, whether in the US or Japan, may therefore initially produce a huge increase in amateur radio activity. But the effect is not permanent, and ultimately a gradual wear-off of activity occurs.

The latest regulatory change occurred in April, 2000, when the FCC relaxed the cw requirement for all classes to 5 wpm. This change had the effect of allowing greater access to the HF frequencies by all amateurs who were stymied by higher code speed requirements. It is felt that many no-code Technicians, Technicians already having passed the 5 wpm requirement, and many non-amateurs, now had a great incentive to upgrade and / or license to General or Extra classes so as to take advantage of greatly expanded operating privileges. With a general migration of newer entry licensee holders to HF frequencies, VHF operating activity declined. Multiple regressions run on a dummy variable simulating the existence of this regulatory change produces statistically significant results at the 95% confidence level. These regressions were not detrended for drifts through time, so a more complete answer as to impacts from the latest regulatory changes will have to wait until a full time series regression analysis involving all known or possible variables can be conducted.

9-2005 update: In August, 2005, the FCC formally proposed the elimination of all code requirements for US amateurs. It is believed that this move (when finally authorized) may also encourage more HF operating activity from the no-code and 5 wpm Tech classes, possibly with adverse impacts upon VHF activity levels.

2-2005 Note on participation in the Big three contests. The differences between the popularity of January in the 1960's and the closeness in log entries in all three of the major contests more currently is also a topic of discussion. I have attributed the increasing popularity of June & September since the 1970's to the modernization of the rules, with the ability of individuals to be more competitive. Zimmerman (2005) believes that January was very popular in the 1960's because it was a club-oriented event. Since the mode of propagation was mostly AM during that time frame, most of the activity was localized in nature. It just took many years for people to favor June and September, with their better propagation characteristics.

Technology could also have advanced by the mid 1970's to the point where distance work was a regular possibility for June and September if propagation was good. This would have then made those two contests more popular. If conditions in a contest were bad, people became disinterested and with less reliance on local AM contacts. Activity then would have declined regardless of what the clubs were attempting to do.

I see this argument as being part of a technology advance type of factor. As technology advanced to the point where longer contacts were increasingly reliable, June and September might have become more popular. As people shifted from AM to SSB, and receiver abilities increased measurably, more people might have begun participating in the non-club contests (although the increase in June and September did not occur until the mid-1970's). The focus was no longer on AM local nets, and much of the reliance on the local groups decreased later in the 1960's. Then, when FM came into the picture in the 1970's, the local activity moved completely away from AM and towards FM repeaters, thus generating a further slide in contest log entries.

9-2005 note: I touched upon some of these thoughts in the above section dealing with the changing modes of communication.

The end of eth 1st era, and the start of the 2nd. Thus, the bottoming out of the 1st cycle in 1975 has been attributed to:

1) The "loss of interest" demographic after 1961 (see Part II comments).

2) Novice and Technician regulatory changes in 1968 and 1972 that negatively impacted both club activity and overall contest activity.

3) Technological increases generating an increasing emphasis on long distance work. Local VHF activity centering on AM then deteriorated, thus accelerating the slide in log entries throughout the 1960's and early 1970's.

4) The increasing usage of FM also contributed to the slide, as VHF activity became centered on non-contest types of communication.

5) The popularity of the CB era in the early to mid 1970's may have also drawn off some interest in amateur radio, in general.

The increasing popularity of June and September beginning in the mid 1970's has now been attributable to:

1) Increasing numbers of US licensees starting in the mid 1970's. This could have been due to license incentive restructuring, but also from the rapid exodus of CB'ers who could have then moved over to amateur radio.

2) A cumulative effect from the modernization of the rules.

3) The Technician reauthorization on VHF in 1978.

4) Additional Novice privileges starting in 1976 and continuing into 1978.

5) Wearing off of the FM craze by the mid to late 1970's.

6) Continued technological advances that allowed one to take advantage of better propagation, thus making the summer contests more popular by the 1970's.

7) Zimmerman (2005) suggests to explore the nature of the clubs in the 1960's. Were they VHF clubs? General purpose clubs? Were these clubs involved with weak-signal work in the 1960's replaced by clubs focusing in the 1970's on FM activity? This might explain the downturn of log entries into the mid 1970's. Perhaps, the clubs by the mid 1970's increasingly focused on DX work.

8) Gene also suggests looking into the geographic distribution of contesting in the 1960's. Were the contests primarily along the two coasts? Now, with activity in other areas of the country picking up, perhaps that could explain why the non-club events increased in popularity. It was now more feasible to work into the mid section of the nation, especially in June and September.

With many of these thoughts as to the bottoming of the 1st cycle and the mid 1970 increases from there, the central belief is that the nature of contesting changed. During the 1st peak, the focus was on local AM activity groups and areas that could easily be cultivated by the contest clubs. Later into the 1960's, as SSB and FM advanced, local activity at a group level on AM gave way to more individually oriented SSB DX work, with groups moving to FM. This made club efforts more difficult, but also paved the way towards an individualized DX type of focus. With the decrease of AM local activity centers but then the corresponding increase in SSB / CW, came more geographic dispersion. The decimation of VHF contesting in the late 1960's actually set the groundwork for a contesting resurgence into the 1970's.

As to the question of why the contests cycle in participation levels instead of increasing in the same proportion as that of the general increase in the amateur population (some four-fold), I also have been told that the HF contests in the US (both ARRL and CQ), and possibly in Europe as well, have dramatically increased in log entry #'s (according to general information supplied by Frenaye). Zimmerman believes there are three reasons: 1) the VHF contests are boring; 2) the VHF contests are too microwave oriented; and 3) there may be lapses in contesting ethics, with generally accepted procedures on VHF being much looser than on HF (skeds in advance; digital confirmation activities during the contest; etc).

I think we are just at the beginning of our understanding to this question, as it goes beyond studying past observable log entry data, and moves towards an exploration of why the numbers aren't higher than they are. I see a more basic reason to the lack of growth in the VHF contests: 4) sociological. A definite finesse is necessary to communicate on the VHf bands beyond anything but a local range. A certain patience and dedication is needed to do well on the VHF bands, and even then, it is a slow go, both during the contests as well as in general operations. Now that so many of the great adventures on VHF have been achieved so many years ago (moonbounce occurred in 1960; MS in the early 1950's; aurora as early as 1939), the fascination of the VHF arena may be gone. Tilton's exploration of unknown or only suspected propagation characteristics have given way to more accurate knowledge of communications abilities on VHF. Amateurs well know that aside from a summer Es on 6 meters and the occasional enhanced tropo on 2 and above, that VHF communications is far more localized than the worldwide possibilities of the HF bands. With the full realization by the mid-1960's that VHF and above was always going to generate localized contacts (with the exception of very difficult areas such as EME and MS), most amateurs simply preferred to occupy the HF bands.

After all these years, the VHf spectrum still attracts the "listeners" of the world. The hyper-active contesters and amateurs of the universe will flock to the HF frequencies. In the end, it simply may be a matter of personality preference. Folks that enjoy the beauty of radio astronomy, the ability of the spectrum to most effectively transmit via tropo at 3 AM on a summer morning, and the willingness to listen for hours on end to the hiss of the radio speakers just so that one may catch the ping of a single MS contact will find something of great usefulness on VHF. People that want constant chatter will stay with HF.

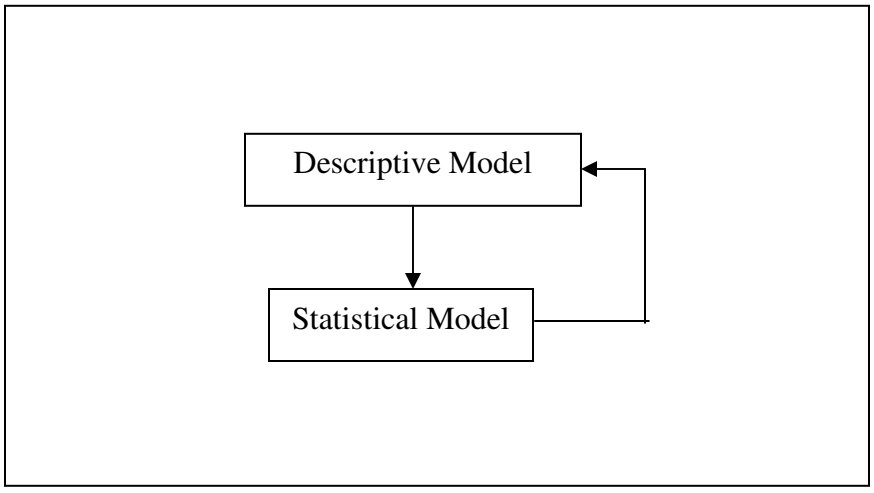
Part II – Towards the Development of a Statistical Model – the 2nd Round / 9-2005

Introduction. Initial work on statistical analysis of VHF contesting activity was conducted in a January, 2005 update and addendum of this document. Various factors were identified and statistically tested with simple regression runs and some multiple regressions. This "1st round" statistical effort concluded that VHF contesting clubs and some regulatory changes were responsible for much of the variation in VHF contest activity.

Since that time, more historical data has been accumulated on both ARRL VHF and CQ VHF contests. Qualitative considerations were further developed. These factors were noted in an article in the *NCJ* in the spring of 2005 on the development of a Descriptive Model. Feedback to this article came from many commentators. Additional factors were identified for use in the Descriptive Model and some of the variables of the statistical model were also modified.

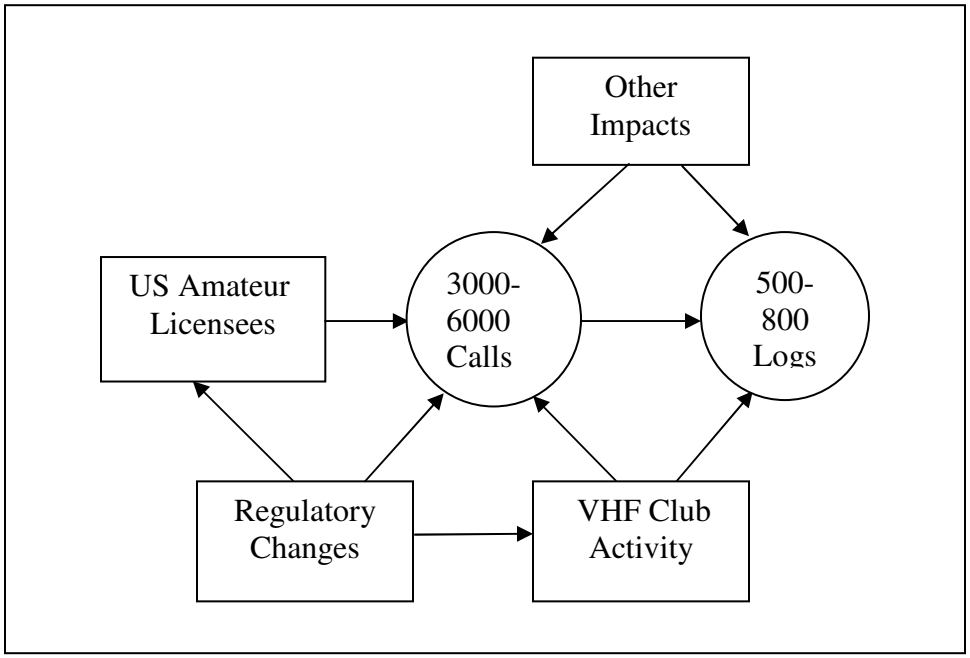
A more involved multiple regression analysis flowed from these recent efforts, complete with time series and autoregressive features and several graphs. Part II of this paper discusses these activities in depth, and as such, should be considered the "2nd round" of a statistical model. Since this part amounts to a complete rewrite of earlier thoughts contained in this paper, Part II is written as of "9-2005".

Methodology. Many of the factors identified in this paper cannot be statistically tested, due to either the lack of available data, or just as likely, the factor not being quantifiable. However, some of the factors thought to influence contest log entries are capable of being statistically tested. The process entails the formulation of one or more hypothesis incorporating factors thought to affect or impact VHF contest activity. The hypothesis can be stated in a Descriptive Model, which is then tested through a Statistical Model. These tests are normally conducted through simple and multiple regression analysis and hypothesis testing. The results of the tests are then feedback into the Descriptive Model, with modifications and revisions made to the hypothesis of the Descriptive Model. A flow chart of the process is as follows.



The discussion of the factors will initially center on single regression runs with one independent variable (x) tested for explanatory power on January contest logs (y). Then the statistical model will be built up to include several variables tested against January logs in a multiple regression, time series format. The variables will also be evaluated against the number of clubs to ascertain whether regulatory matters may have affected both January totals and club activity levels.

The Descriptive Model. A qualitative model outlining the various factors previously identified as affecting VHF contest log activity was developed in "A Descriptive Model of VHF Contesting Activity", *NCJ*, Spring, 2005, and an extensive outline of the Model is available at the SMC VHF web-page. The following flow chart is taken from that article:



The Statistical Model. The functional form can be expressed as:

$$y = \int (x_1, x_2, \ldots..x_n)$$

where, y is the dependent variable being tested, and the x's are the independent variables that may explain the variation in y. The general equation used for linear regression analysis is:

$$y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} \ldots. + \beta_n t + u_t,$$

where y_t is the dependent variable in time period t; β_0 is the y intercept; β_1 is the parameter for variable $X_{1t;}$ the variable X_{1t} is the independent variable X1 in time period t; "t" is the time period; and u_t is the error term, or residual in time period t. By adding t into the equations, it is hoped that time trending of the data can be identified, and spurious correlations between the variables can thereby be avoided. The estimated equation that is used for testing then becomes:

$$y_t\text{^} = \beta_0\text{^} + \beta_1\text{^}\, X_{1t} + \beta_2\text{^}\, X_{2t} \ldots. + \beta_n\text{^}\, t$$

Contests Tested. The January VHF SS is often used for evaluation purposes, due to its popularity over the years and most importantly, availability of club competition information. Other contests can be used of course, but since the club competition started only recently in the June and September events, data concerning the clubs is generally unusable for these contests. Therefore, the statistical discussion will be centered on the January contest. Possibly, conclusions reached regarding January may apply to other contests as well.

Variable List and Data Sources. The following factors of the Descriptive Model have been developed into variables that can be tested through the estimated equation.

"Jan" – This is the total log entry for each January VHF SS from 1948 to 2005. Data comes from ARRL on-line sources; Gene Zimmerman's summary of log entry numbers back to 1992 (published in a *World Above 50 MHx* column, April, 2004); an Excel spreadsheet from Curt Roseman, K9AKS containing historical data on the contest back to 1948; a review of old contest reports and write-ups in QST, and manual counting by the author of this paper of various years of contest results. An historical data file containing all statistics on the January VHF SS is available at the SMC web-site, VHF web-page.

"SSN" – The solar sunspots, with data coming from NASA's on-line site, for the period of 1948 to 2005.

"Clubs" – the number of clubs having three or more log entries in the January VHF SS. The club numbers come from a review of old *QST* write-ups and results, and a manual count by the author of several years of club statistics contained in the contest write-ups.

"Club logs" – the total log entries from members of the clubs. Data comes from a review of old *QST* write-ups and results, and a manual count by the author of several years of club statistics contained in the contest write-ups.

"6 Mtr Ops" – The number of log entries that made one or more contact on 6 meters in the January VHF SS from 1948 to 1975. Data from 1948 to 1960 is from Ed Tilton's graphs and notes contained in his *World Above 50 Mc* column (1957, 1959, 1960). Data of various years between 1960 to 1975 comes from *QST* write-ups, where available, and from Excel files that are generated from scanned copies of contest results. Data form 2002 to 2005 is from the ARRL on-line data base.

"2 Mtr Ops" – The number of log entries that made one or more contact on 2 meters in the first era of VHF contesting, generally described as 1948 to 1975. Data is form the same sources as 6 Meter contest band activity.

"6 Mtr Reg" – a dummy variable set to 1 in 1956 to 1968. This is designed to measure the "1st era" regulatory impact from 6 meter Tech authorization in 1955 until the first date of Technician restrictions on 6 meters.

"2 Mtr Reg" – a dummy variable set to 1 from 1952 to 1968. This is designed to measure the "1st era" regulatory impact from 2 meter phone authorization of Novices between 1951 and 1968, and secondarily, Technician authorization on 2 meters after 1959.

"US Ops" – the number of licensed US amateurs. Recent years are generally from Joe Speroni's excel file, 1997-2005; 1966-1997 data is generally from the Radio Amateur Callbook, annual editions, ham census page; data form some years between 1952 and 1966 is from *CQ*, where available, with CQ generally reciting FCC annual statistics. Some older years in which no other data source is available (some of the 1960's) is estimations made by Speroni back to 1960.

"Grad" – An abbreviation for "gradual". This is a dummy variable set to 1 from 1978 to 1991, and is used in combination with "US Ops" (i.e. US Ops * grad) to measure US operator totals during the period of Novice and Technician license and privilege restructuring in the 1970's and 19080's. The dummy variable could also be set for 1 at 1974, to measure the combined impact of demographic movements to and from CB activity, and Novice and Tech privilege restructuring; or 1 = 1967, to measure the combined impact of the licensing incentives along with the other items; or setting the dummy variable at 1 from the 1970's to the present, to also include the dramatic rise in Technician totals starting in 1992. The discussion below generally used 1 = 1974 to 1991, to isolate the effect upon January contest activity from a gradual increase in US operator licensee totals starting around the time of the 1974 contest minima.

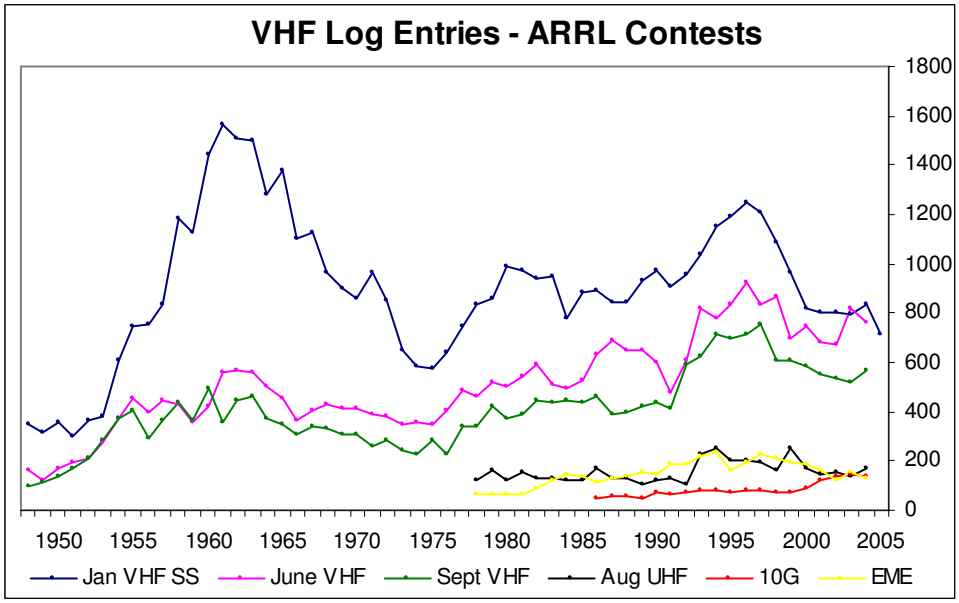
"Techs" – This is the number of US Technician licensees from 1992 forward. Data is from Speroni, 1997 to 2005; and RAC before 1996, generally.

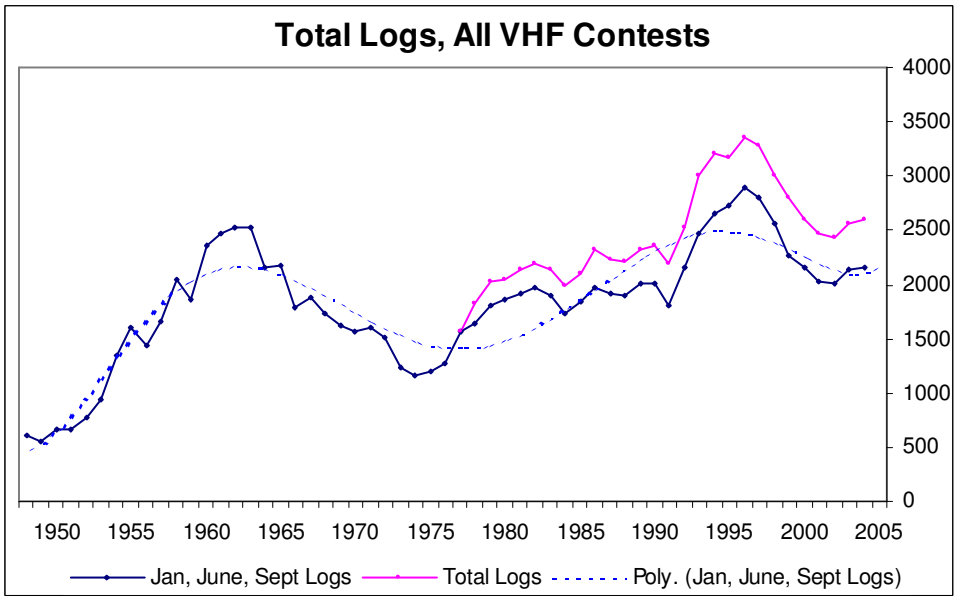
"Tech dummy" – this is a dummy variable set to 1 from 1992 forward, and is used in combination with the Tech operator totals (i.e. Techs* tech dummy) to measure the effect of no-code authorization starting in 1991 (the first January VHF SS that had no-code Tech was 1992).

"LOS1" – This is a dummy variable set for 1 from 1962 to 1972, and is designed to measure the effect of a possible loss of interest in VHF contesting and activities for a 10 year period following the 1st peak in 1961.

"LOS2" – This is a dummy variable set for 1 from 1997 to 2006, and is designed to measure the effect of a possible loss of interest in VHF contesting and activities for a 10 year period following the 2st peak in 1996.

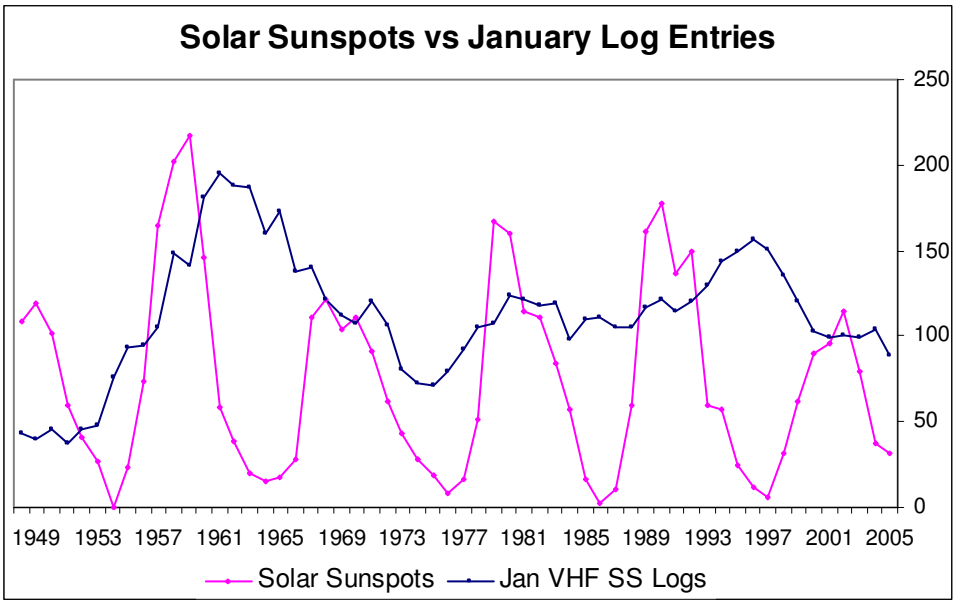
Overall Log Entry Statistics. Contest log entry numbers for all six ARRL VHF contests is contained below, as well as the aggregation of all contest log entries. The trend-line for the three main VHF contests (January, June, and September) is so predictable that a 6th order polynomial captures 83% of the log entry variation of the trend-line. The polynomial trend-line has local minimas at 1949, 1974, and 2002, and local maximas at 1962 and 1996.





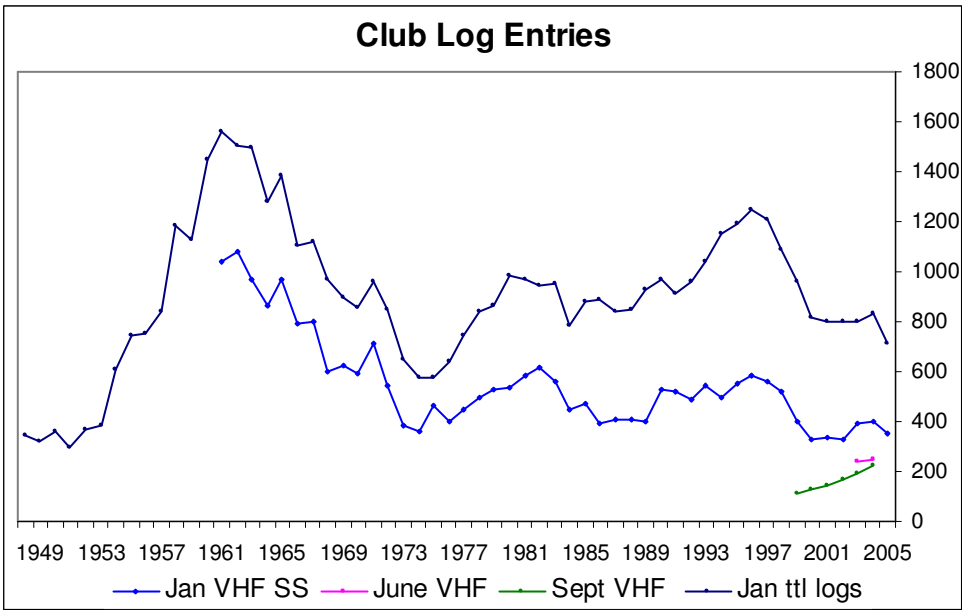
Regressions on January VHF SS log entries. Any number of items has been postulated as causing the peaks and valleys in VHF contesting.

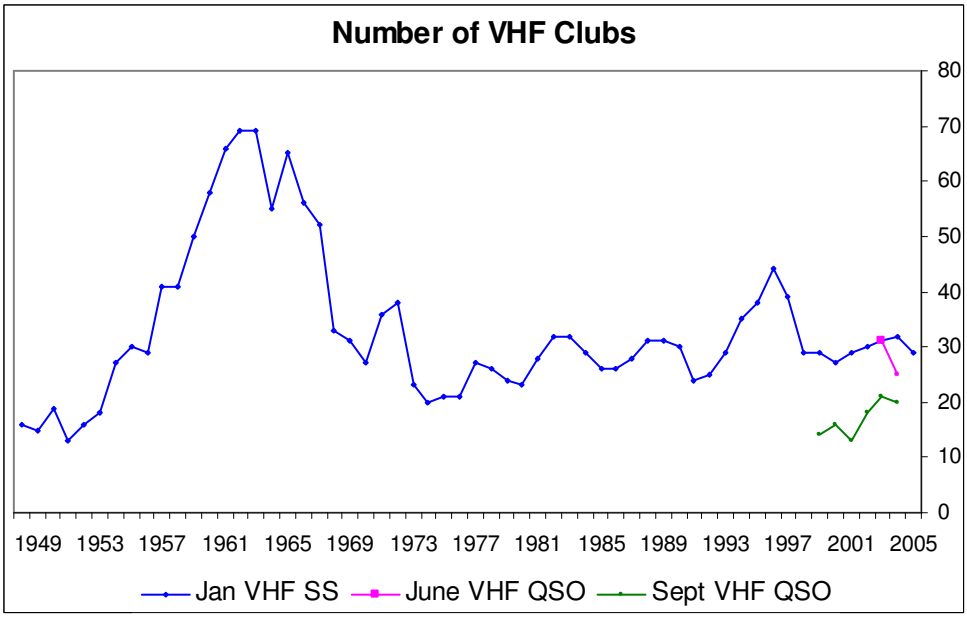
The solar cycle has long been known to play a role in propagation on HF, and a recent article suggests that the solar cycle may be affecting amateur activity in HF contests (Harker, 2005). Some people have also entertained the notion for VHF contesting. The following graph summarizes SSN versus January log data.



Simple linear regression analysis (without time detrending) showed that SSN's were not statistically significant in explaining contest log variation. With a t statistic of .332 and a R^2 value of .001, there is little or no relation between SSN and log entries over the entire 55 + year history of VHF contesting. The three year time lag between peak of the solar cycle and the 1961 contesting peak is interesting (as is the low of the next solar cycle and the 1974 contesting minima), but notice that there are parts of two solar cycles from the 1961 peak to the 1974 minima. Also notice the solar minima in 1996, the year of the second great contesting peak.

Club activity. Affiliated clubs have always been a major influence in VHF contesting. The graphs below show the impact. Notice the similarity between the trend in the January logs and that of both club numbers and club logs.





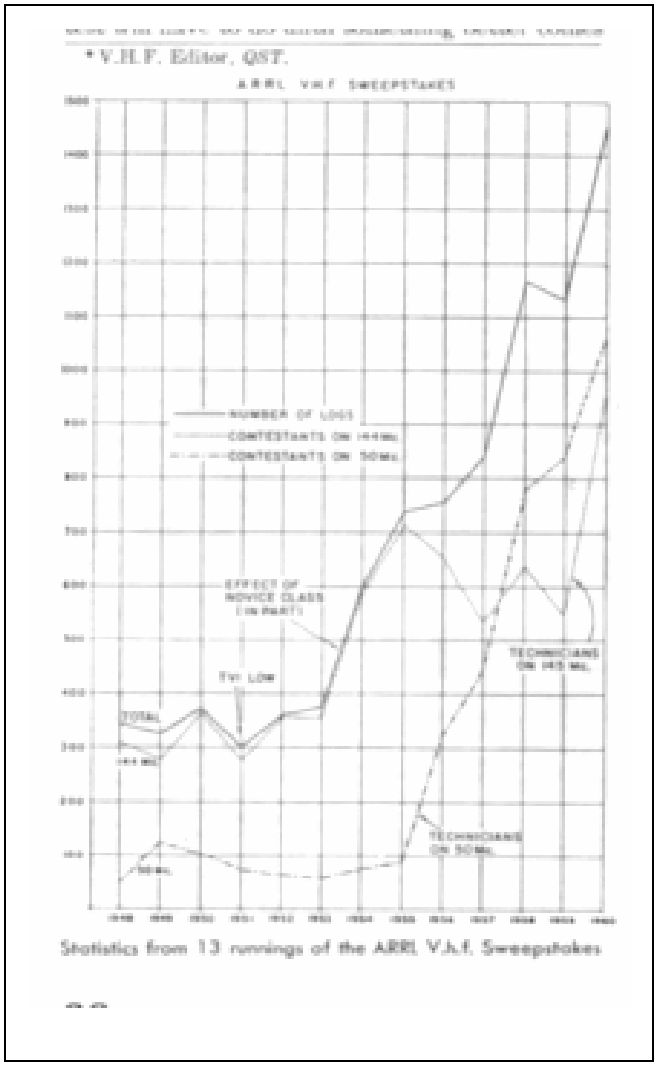
Both the number of club member logs and the number of VHF clubs are statistically significant, and produce a high degree of explanatory power. Club member logs explain 71.6% of the log entry variation (and with a t statistic of 10.43), while the number of

VHF clubs explains 73.6% of the log variation (t statistic of 13.45). Both sets of numbers are based on simple regression analysis, before the introduction of time de-trending and other independent variables.

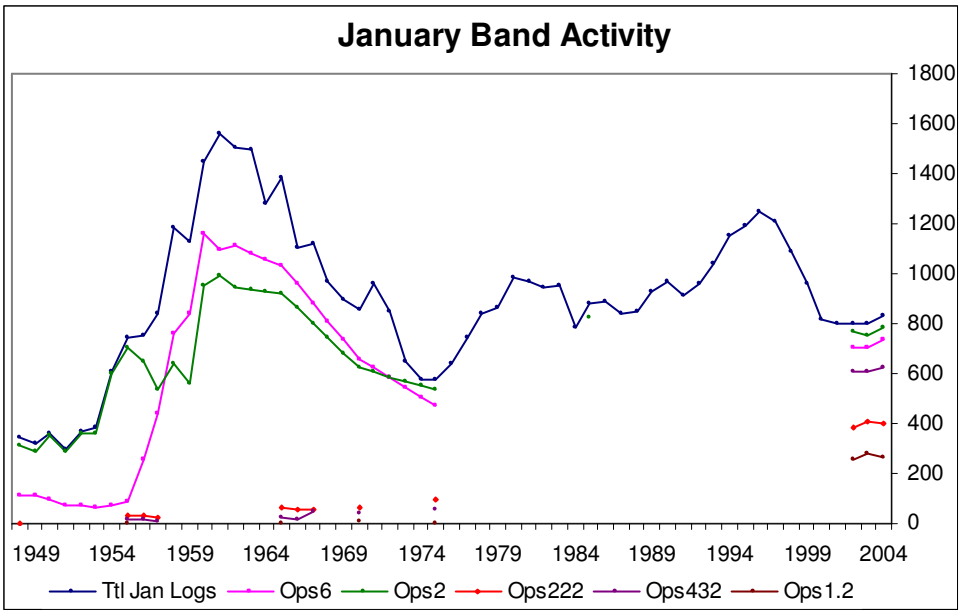
There is one concern with using club member logs however, in measuring the impact on January log entries. Club member logs should probably not considered an independent variable in which to test the dependent variable, January logs. Since club logs comprise a smaller set of the overall number of January logs, there will tend to be a correlation between the two sets of data. Whenever the number of club logs increase, the number of January logs must increase. While this of course is a desirable thing for contest log activity, it tends to pose problems for statistical analysis, since the number of club logs is not independent of the Y variable being tested. A far better variable for statistical testing purposes is the number of participating VHF clubs. This variable is not a sub-set of the January logs variable, and yet could clearly measure the influence of the clubs upon contest log entries. In fact, it has more explanatory power upon the number of January logs than does the number of club member logs.

Additionally, using both the VHF club variable and the club member log variable in multiple regression analysis would introduce auto-correlation problems between the two club variables, as they are highly related to each other, as well as to the number of January entries (Both variables were used in the January, 2005 draft of this paper, and auto-correlation problems were highly evident in the results). The working thesis is that the number of VHF clubs affect the number of VHF club member logs which in turns affects the number of January VHF log entries. Just using the VHF club variable would tend to capture the large bulk of the "club impact" upon January logs, would be an independent variable, and would not generate auto-correlation concerns. The decision was therefore made to only use the VHF club variable in the multiple regression runs.

Regulatory Effects – the 1st Peak. Authorization of Novices on 2 meters in 1951, Technicians on 6 meters in 1955, and Technicians gaining access to 2 meters in 1959 generated a huge influx of newer hams on the VHF bands, and consequently, to VHF contesting. In a series of contest reports and World Above 50 Mc columns (1957, 1959, 1960), Ed Tilton vividly showed the impact from these newer authorizations. From Tilton's 1960 article on the subject:



Tilton retired from his VHF column later in 1960. Had his analysis continued into the following years however, it would have shown the decline in 6 and 2 meter band activity after the 1st peak in VHf contesting in 1960. In particular, Novices were prohibited from 2 meter phone starting in 1968, and Technicians were prohibited from 6 meter cw at the same time. This resulted in a complete freefall in Novice 2 meter activity, and possibly some loss of activity among the Technicians, as well. Novices were then completely prohibited form 2 meters in 1972. Extending Tilton's graphs through 1975 produces the following:



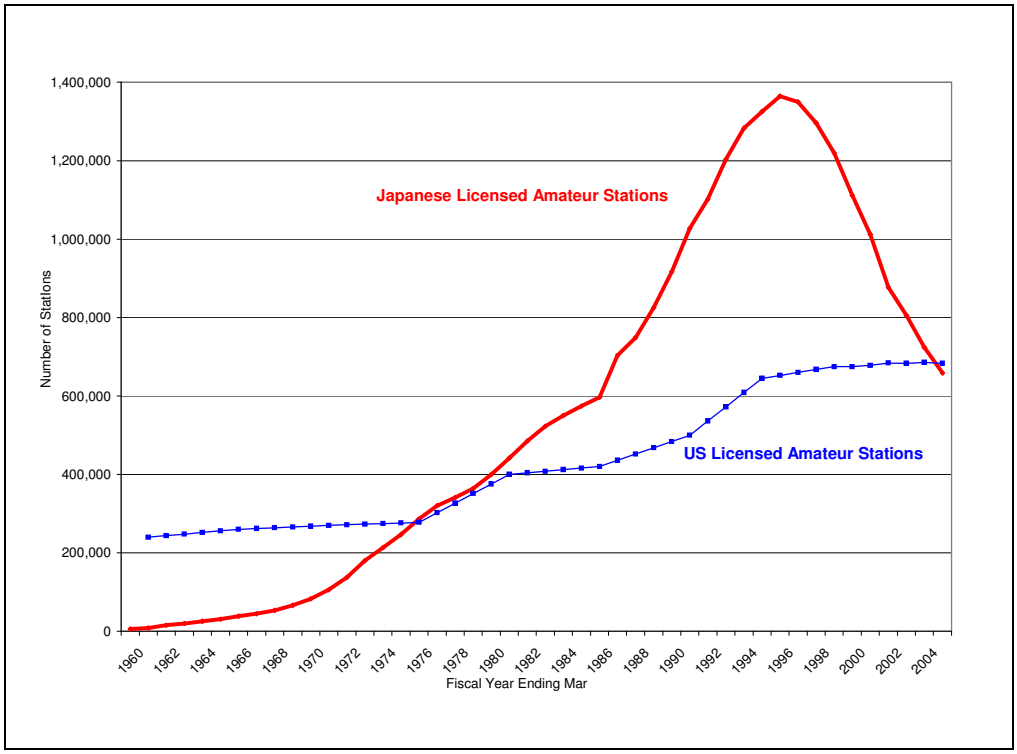
Regression runs on 6 and 2 meter band activity show a clear correlation with January log entries. 87% of the variation in January contest logs was explained 6 and 2 meter band activity. While the impact of these above noted regulatory changes in both the 1950's and 1960's upon VHF contest activity is obvious, using contest band activity as a proxy for the regulatory changes develops statistical problems. Band activity is essentially a sub-set of the broader January total logs – Contestants will work 6 or 2 meters and will also submit a contest log. Thus, we are back to the dependent variable problem. The January, 2005 draft of this paper encountered statistical significance and bias difficulties of the band variables.

To deal with the problem, we can move away from Tilton's method of using 6 and 2-meter band activity to measure the effect of regulatory changes by developing dummy variables that simulate the regulatory effect. Because dummy variables can isolate certain periods of time that might be systematically different than other periods, dummy variables can be very useful. "6 Mtr Reg" is set to 1 from 1956 to 1968 (and 0 from 1948 to 1955; 1969 to present), while "2 Mtr Reg" is set to 1 from 1952 to 1968 (and 0 from 1948 to 1952; 1969 to present). Running a regression of these two variables against January contest logs through 1975 and through 2005 produces the following statistics. A run on the entire period through 2005 is the preferred statistical procedure, as we can then more readily isolate the regulatory effects in the 1st era of contesting from various impacts in other time periods.

Variable	R2	t stat
6 mtrs to 1975	0.633	6.71
2 mtrs to 1975	0.304	3.37
6 mtrs to 2005	0.331	5.27
2 mtrs to 2005	0.112	2.66

Dummy variables, by themselves, do not provide much depth to the testing process since the variables are only a yes or no choice (1 or 0). Combining the dummy variables with Novice and Technician operator totals would generate more detailed information that could then be used to compare against January log totals. Statisticians refer to this as interaction between variables. Unfortunately, there are a few problems with such attempts. Available data for that period is spotty at best, and when it is available, the exact sampling methodology is unknown or problematic. Just as importantly, Novice and Tech operator numbers may not be overly meaningful. Novices at that time held one-year nonrenewable licenses, but a popular option was for Novices to upgrade to Technician while simultaneously retaining the Novice license (this was allowed until 1968). This would produce a double-counting of new VHF operators, with one VHF contestant being counted as two operators in the US amateur population. The decision was therefore made to just use the dummy variables as the proxy for 1950 and 1960 era regulatory effects, instead of using contest band activity or dummy variables * tech and Novice operator numbers.

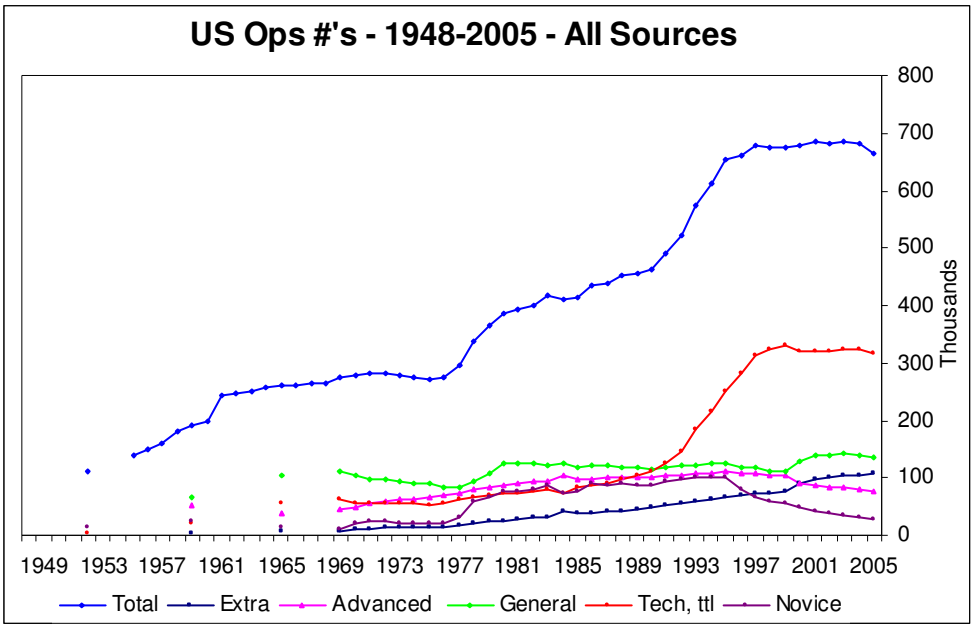
Loss of interest, 1st peak. In both contesting peaks, nothing of a negative regulatory nature occurred for several years after the peak. Novice and tech restrictions were in effect in 1968, some 7 years after the peak. There were even some positive regulatory changes in the period: in 1963, 432 power limits were increased, for instance. In the 2nd peak, no negative regulatory changes occurred for at least 4 years (CW requirements for all HF frequencies, were relaxed to 5 wpm, making HF comparatively more attractive to explore). And yet, log entries became only a fraction of their peak year levels. It has been postulated that reduced contest activity was related, in part, to a general loss of interest and / or license upgrades to HF SSB privileges. This loss of interest effect is especially pronounced in Japan, where the license period is 1 to 2 years. Loss of interest shows up in Japan's licensee totals and not just contesting log entries to due the short renewal periods (unlike the US with a 10 year renewable period). The following graph comes from Joe Speroni (2004).



To simulate the potential loss of interest during the 1st era of VHF contesting, a dummy variable was set to 1 for a 10 year period after the first peak. Regressing this loss of interest dummy variable against January log entries from 1948 to 2005 produced an R^2 of .162 and a t statistic of 3.29. Of course, other items many have also been responsible for the downdraft in VHF contest logs from 1962 to 1972 – such as adverse regulatory effects (noted above) and a shifting away from AM and towards SSB (and then FM in the 1970's). Multiple regression analysis can sort through the dual effect of two or more variables acting on the dependent variable, January log totals, in the same time period. The shifting of the communication modes is a qualitative factor that has so far been untestable. To that extent, the mode shift (along with all other untested or untestable factors) would be treated statistically as being part of the residual error term. These are factors or influences that are only noted in the size of the unexplained residual. The more untestable variables there are (and the greater their significance), the higher the residual will be.

US Op totals, 1970's-1980's. The total number of US amateur licensees gradually climbed starting in the mid 1970's (1977, to be more precise). Many reasons for this increase have been postulated: incentive license restructuring beginning in 1967, with a gradual 20 year rise in extra and advanced licensees; the rise and fall of the CB era, which first produced negative impacts on US amateur totals, but then positive impacts once the CB craze wore off; the adoption of more permissive rules for Novices (VFO usage and 250 watt power levels in 1978; elimination of the WN prefixes in 1967; 2 year renewable licenses in 1968); and the authorization of Technicians on 10 meters and 6 meters in 1978. Whatever the reasons, the increase in US amateur numbers beginning in

the mid 1970's arguably contributed to VHF contesting log entry increases simply because there were more amateurs licensed to operate all bands, including VHF. Estimated US amateur totals are contained below.



Running regressions from 1948 through 2005, and using various dates for the start of the dummy variable generates the following:

US Op Totals, 1948 to 2005 runs

Dummy=1	R2	t stat
1967-1991	0.039871	1.524955
1974-1991	0.072745	2.096021
1978-1991	0.014583	0.910350

When the test period is isolated to the pre-no code Tech regulatory changes, various explanatory powers emerge, depending on the start date for the dummy variable. If one starts at 1978 (which is when Techs and Novices gains significant privileges on HF and VHF), the explanatory power for regulatory changes upon January contest totals is not overly large nor statistically significant. Even when the test period coincides with the 1974 VHF contesting minimum (nothing significant happened around that time in terms of regulation, so one has to wonder about data mining problems in picking 1974 as the start date), the explanatory power only marginally improves. This conclusion changes remarkably when a time series format is introduced (see multiple regression analysis, below).

No-Code Technicians. The impact from the grant of no-code Technician privileges in 1991 was direct and immediate. US amateur licensee numbers surged while VHF contesting activities boomed. Virtually all new licenses issued for several years after 1991 were in the no-code Technician class. Simple regression runs on Technician licensee totals from 1992 forward (tech dummy: 1992-2005=1; 1948-1991=0) have an explanatory power on January contest log totals of 55.3% and are highly significant, statistically. Including the 1992 and forward period in US operator totals remarkably changes the above conclusions as to US licensee totals not overly affecting VHF contesting activity. Starting with incentive licensing in 1967 (US op dummy: 1967-2005=1; 1948-1966=0), a regression run on the entire contesting period since 1948 generates an amazing 94.6% explanatory power on January contest log entries. Thus, when one considers the entire period from 1967 forward, instead of just trying to isolate the regulatory effects from certain eras, almost all of the variation in contesting activity can be explained by regulatory effects.

Loss of Interest, 2nd era. The downtrend after the 1996 peak is quite apparent in even a cursory glance at the contest activity graphs. When a regression is run on this period however, (LOS2 dummy: 1997-2005=1; 1948-1995=0), almost no explanatory power occurs for the entire period for 1948-2005. This may be due to the relative lack of sophistication in the use of simple dummy variables without the combined use of other numerical values (for instance, US ops totals * a dummy variable). The conclusion also changes when a time series format is introduced.

Single Regressions in a Time Series Format. Two time series variables may be trending in the same direction, but a non-trended analysis could then give the appearance that one variable influences the other, when in fact, they just happen to be moving in similar patterns across time. Time series analysis eliminates the possibility of a spurious relationship between the variables, and this may produce results markedly different than non-trended regressions.

With time series, the explanatory power of the regressions are often very high compared to cross series data, due to trending of the data. Serial correlation between variables and the error term can be tested through Durbin-Watson and other statistical techniques. By regressing the residuals in a feasible generalized least squares estimation (FGLS), the time trends can be netted out, with inferential tests (the t statistic and F test) being valid and the errors of the estimated equation being less serially correlated than in an ordinary least squares model (OLS) in the presence of serial correlation.

The following results are of time-series regressions, with regressed residual values from each independent variable being evaluated for impact on the dependent variable, January contest log entries. Auto-regression 1 (AR1) is used throughout the time series runs in this Part of the paper, unless otherwise noted.

January Logs versus:

Variable	Regressed R2 (Yule-Walker estimates)	t stat	Durbin-Watson
Solar Spot #'s	.0018	-0.32	1.4269
# of Clubs	.5273	7.83	1.8662
2 Mtr Reg	.0204	1.07	1.4569
6 Mtr Reg	.0306	1.32	1.3790
LOS 1	.0087	0.70	1.3950
US Ops, 1970's	.0026	-0.38	1.4265
Techs, 1990's	.0092	0.71	1.4466
LOS 2	.0022	-0.35	1.4322

The only time de-trended single regression run with any statistical significance was the number of clubs variable, with a t stat of 7.83 (meaning that it was strongly significant at the 95% confidence level), a Durbin-Watson of under 2.00 (showing that the variable was not serially correlated with the residual error term to any great extent), and an explanatory power on the y variable of 52.73%. The other independent variables, including the interactive variables of US Ops in the 1970's and Technician in the 1990's, were not individually statistically significant, once the series was time de-trended.

Multiple Regressions in a Time Series Format, with January as the Dependent Variable. By gradually adding variables into the model, we can gauge the increase or decrease in the adjusted R^2, and measure the statistical significance of each variable as it is introduced into the model. This produces a more sophisticated view of how each individual variable benefits or detracts from the overall scheme of the model. For example, some of the regulatory variables become statistically significant, once they are presented in an autoregressive multiple regression format. Regressed R-Square values for the various runs show a progressive build-up in predictive ability of the model, as shown by the following:

January Logs versus:

Variable	Regressed R2 (Yule-Walker estimates)	Durbin-Watson
Clb Ttl	.5273	1.8662
+ 2 Mtr Reg	.6544	1.5624
+ 6 Mtr Reg	.6582	1.5316
+ LOS 1	.6755	1.4892
+US Ops, 1970's	.6885	1.5348
+Techs, 1990's	.7107	1.6536
+LOS 2	.7812	1.6651

The participating affiliated clubs provide a large base of explanatory power for the January contest log entry totals. As regulatory variables are then added into the model, the explanatory power gradually rises. The full model, with the club variable and 6 other variables designed to test various regulatory impacts, provides an explanation of 78.12% of the contest log variation in the January VHF SS total. At all times, Durbin-Watson is under 2.00, indicating that serial correlation problems are within tolerable levels. A more complete output of the Model's regression, with autocorrelation error results is as follows:

Regression with Auto-Regressive Errors
Dependent Variable: January logs

Yule-Walker Estimates			
SSE	457747	**DFE**	49
MSE	9342	**Rt MSE**	96.6529
SBC	721.801	**AIC**	703.257
Regr. R2	0.7812	**Ttl R2**	0.9080
D-W	1.6651		

Variable	FD	Estimate	Std Error	t Value	Pr > |t|
Intercept	1	195.286	66.3008	2.95	0.0049
Clb ttls	1	17.3431	2.0441	8.48	<.0001
2Mtr Reg	1	-28.027	75.6665	-0.37	0.7127
6Mtr Reg	1	95.4133	83.6322	1.14	0.2595
LOS 1	1	52.6321	60.8275	0.87	0.3911
USop70s	1	0.00046	0.00015	3.13	0.0030
Techs90s	1	0.00119	0.00036	3.29	0.0019
LOS 2	1	-200.75	97.4395	-2.06	0.0447

The number of clubs, the US operator totals from 1974 to 1991, and the number of Technicians from 1992 to 2005 are statistically significant in explaining the variation in January VHF SS log entries. The other four variables are not significant in explanatory power, although they still add to the overall explanatory power of the entire model. Perhaps this is due to these four factors being only dummy variables, without further depth as interactive variables. In regressions on 6 and 2 meter contest band numbers done in the January, 2005 version of this paper, the regulatory changes in the 1950's were statistically significant, but with autocorrelation problems. Thus, R2 likely would be higher if the regulatory changes of the 1950's could be measured in a more in-depth manner. Even considering the lack of detailed information on the dummy variables, it is interesting that 78% of the variability in the January totals can be accounted for by the variation in the independent variables tested. The residual error term of 22% incorporates all other qualitative and/or non-tested variables noted in Part I. Thus, the vast amount of variability in VHF contest activity can be statistically traced to club activity and a few major regulatory changes that have impacted VHF amateur log entries.

Multiple Regressions on Clubs Totals. While it evident from the above analysis that club participation greatly affects VHF contest activity, the noted regulatory changes have also greatly affected the clubs themselves. The regulatory variables of the statistical model not only affect the dependent variable, January VHF SS log entry totals, but the same variables and factors have such a large impact on VHF activity that the clubs are likewise affected by regulatory changes. While club activity can be said to be an independent variable that partly explains the variation in January contest log entries, club participation in turn is dependent upon regulatory changes. This is shown in the following multiple regression, using the same time series autoregressive procedures as with the January VHF SS log entry variable.

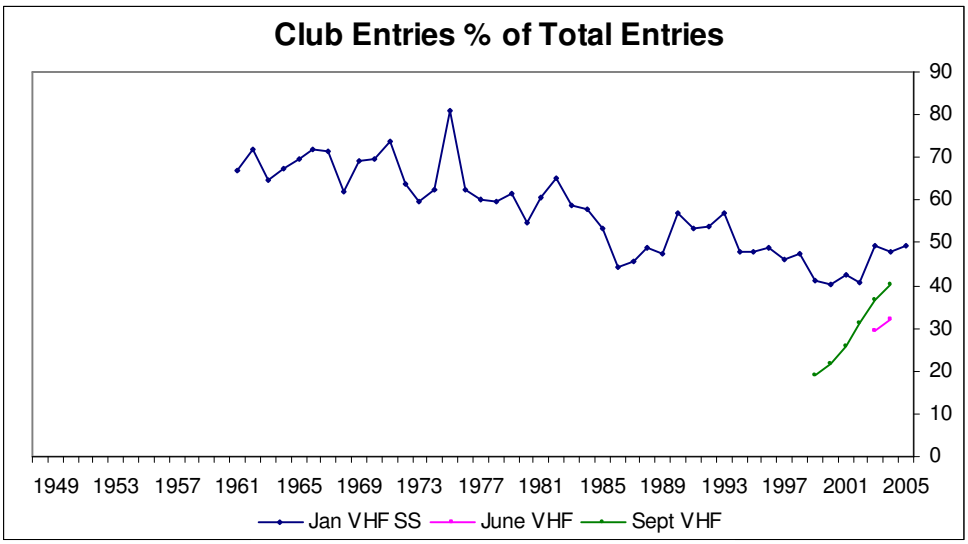
Regression with Auto-Regressive Errors
Dependent Variable: # of Clubs

Yule-Walker Estimates			
SSE	2265.95	**DFE**	50
MSE	45.31912	**Rt MSE**	6.7319
SBC	409.8243	**AIC**	393.3408
Regr. R2	0.5326	**Ttl R2**	0.7831
D-W	1.6941		

Variable	FD	Estimate	Std Error	t Value	Pr > |t|
Intercept	1	22.2839	3.1904	6.98	<.0001
2Mtr Reg	1	4.6425	5.1357	0.90	0.3703
6Mtr Reg	1	17.5328	5.2368	3.35	0.0016
LOS 1	1	9.6779	3.9118	2.47	0.0168
USop70s	1	0.00001	9.71E-06	1.19	0.2401
Techs90s	1	0.00005	0.0000232	2.42	0.0193
LOS 2	1	-9.598	6.214	-1.47	0.1473

The regulatory variables now explain 53.26% of the variation in the number of clubs. This lowered R2 value compared with the January VHF SS log entry numbers is due to the club variable being taken out of the independent variable list, so that it can be evaluated as a variable dependent upon regulatory factors. The D-W test is once again under 2.00 for the regressed equation, showing that serial correlation is not a serious problem. Many of the individual variables are now not statistically significant, individually, including the interactive regulatory factors.

Club activity as a proportion of total contest log entries has been falling since the early 1960's (Role of the Club, 2005). Data on club log entries is available from 1961 on the January VHF SS, and is available since the start of the club competition in the June and September events.



From the above graph, club member logs accounted for 70% of all contest logs in the early 1960's, but today, only amounts to around 50% of contest activity. Interestingly, June and September club percentages started out much lower, but have recently been building towards more significant percentages. The reduction in club involvement in the January VHF SS may be due to the technological and rules changes over long time frames. As SSB supplanted AM in the late 1960's as the dominant mode of voice communication for tropo and weak-signal work, club sponsored AM activity nets withered. More amateurs became interested in working longer distances than in working across town on Gonsets and Lunchboxes. Further, the rise of the bigger multi-ops and mobiles and rovers in coordinated activities during the 1980's gave non-club members the ability to compete more effectively in the VHF contests. For example, June and September, both of which were non-club events until recently, increased their popularity starting in the mid-1970's.

Overall, multiple regressions involving the number of clubs as the dependent variable shows the tremendous effects from certain regulatory changes. This is consistent with the Descriptive Model, noted above, where regulatory changes have impacted not only the contest entries from non-club members, but have also had a tremendous impact upon club activity in January VHF contest.

Limitations and Possible Expansion of the Model. The use of statistical analysis is common at many professional levels, but is subject to many caveats and conditions. The statistical model presented here should be viewed as a second round effort, after feedback was supplied following initial publication of a Descriptive and Statistical Model. To that extent, the process to ascertain the reasons for the dramatic contest log variations is working. The hypothesis or working thesis formulated in a descriptive manner has been statistically tested. The results of the tests are feedback into the model, producing a modified hypothesis, ripe for further testing. This is not to say however that this second

round of statistical analysis is the end point. On the contrary, it may just be the beginning to a more complete understanding of the causative factors involved in amateur radio contesting activity levels.

Limitations and Cautions on Statistical Analysis. The explanatory power of the model (adjusted R^2) generally rises as more variables are added. We should not be overly fixated on this number, as it is conditioned upon several statistical assumptions being maintained as well as the validity of the significance of the individual variables.

Even though the R^2 may increase, the statistical significance of many of the variables can be reduced through the introduction of still other variables. This occurs from correlations between the independent variables, making the inferences and conclusions of the model much more clouded and complicated. Potentially, some of the classical assumptions of regression analysis may be endangered by correlations that are not more fully considered. More sophisticated analysis may have to be conducted to more better understand and identify impact from the variables. Issues involving autocorrelation, heteroskedasticity, etc, must be addressed before more definite conclusions can be made.

Generally, these statistical efforts are interesting. **But we should not, as of yet, read too much into the results.** We should be cautious about quoting an exact percentage of variation in entry log data being explained by the variation in independent variables. The adjusted R^2 values are so high as to draw suspicion, and the indirect nature of several of the regulatory variables may also cast doubt on the results. Then there is the matter of technological changes and other items that are thought to impact activity, but which are qualitative in nature and are not easy to quantify. These variables may be locked into the "residual" error term of any regressions contemplated.

In addition, the historical data itself has been compiled from several sources using a combination of manual counts, simple recitation from published sources, and mathematical counts using Excel. As such, the data should be seen as only a "sample" of an unknown (and probably, unknowable) population of information.

On a small note of reassurance, in the first round of statistical tests conducted in January, 2005, all of the multiple regressions were jointly significant. In conjunction with this is the fact that the adjusted R^2 kept rising as more variables were added into the estimated equation, even though many of the individual variables became insignificant. This same process was seen in the second round of statistical tests, with the regressed R2 increasing as more variables were added into the autoregressive time series regressions. This shows that the model may offer a measure of explanatory power between all variables, jointly, even though the variables, individually, may be somewhat correlated with each other. High levels of correlation between independent variables do not necessarily violate the classical statistical assumptions so long they are not perfectly correlated with each other.

A more troubling scenario would occur if the variables become correlated not only to each other, but to the residual error term. This could invalidate the test statistics. However, the auto-regressions (set to a lag of AR1) generally support the independent

and identically distributed classical assumption of statistical analysis. This implies that the test statistics and inferential stats such as the R^2 numbers may be valid. The R^2 in the AR1 tests are certainly consistent with the earlier tests, outlined above. When auto-regressions with higher orders (AR10) were recently conducted in September, 2005, most of the t values for the lagged coefficients were of very low amounts, and only AR1 has a t value approaching statistical significance (-2.53). Durbin-Watson for AR10 was 1.8418, which still supported a general lack of serial correlation from the time series.

Possible Expansion to the Model. The above procedures on determining the validity of inferential statistics provide some credence to the overall explanatory power of the model. However, other items to consider including in the model are:

- the use of quadratic, log, or exponential dependent and independent variables;

- the use of lagged regulatory or rules related variables. This would be especially relevant for factors that take a few years to accumulate (some of the rules revisions, for example; a gradual, 20 year increase in extra and advanced licenses from incentive licensing in 1967, etc;).

- The development of event types of studies for rules and regulatory changes with specific start dates. The number of clubs variable makes an ideal fit for time series regressions, since this variable has existed in every year of the January VHF contest. But, major regulatory and rules changes have more of a "start date" and "wear off" associated with them, and may therefore be more suited for an event study type of statistical analysis.

- The use of cross-correlation graphs. This would visually and statistically show the relationship of an independent variable on a dependent variable, and may do so in a way that is more understandable than regressions.

- Adding data for US ops prior to 1960; adding variables for Novices # from 1951 forward; adding Tech # from 1951 forward. The impacts from regulatory changes may be more directly measured if Novice and technician licensee numbers could more accurately developed (and assuming that the double-counting of Technicians prior to 1968 could be sorted out). Having Novices or Techs #'s * dummies would produce a more in-depth interactive variable, similar to US ops in the 1970's or Tech in the 1990's.

- Breaking up the 2 meter regulatory dummy variables in the 1950's into two variables to measure the impact from first adding Novices to 2 meters in 1952 and then Technicians to 2 meters in 1959. Other variables could also be developed for various restrictions in the late 1960's and then assorted reauthorizations starting in the late 1970's.

- Possibly, separately identifying major individual rules changes, although it does not appear that any of them have much effect on log entries, by themselves.

References. An extensive bibliography, containing all of the cited articles noted from this paper, is available at the SMC VHF web-page, entitled “Outline and Biblio”.