SR&ED Newsletter
Edition 2012 –3

Recent developments to Scientific Research & Experimental Development (SR&ED) project management & tax credit claims.

Recent SR&ED tax cases & related issue(s)

Copies of the judgments are available from the Tax Court of Canada's website.[1]

Murray Arlin Dentistry PC – adequate documentation[2]

Facts:

The appellant is a professional corporation that operates the dental practice which specializes in implants.

Fifteen years ago, Dr. Arlin purchased a computer software program called the Tritan Dental Implant Management System, which is designed to track the success rate of various types of dental implants.

Dr. Arlin uses the software to compare the success rate of implants in different circumstances. Some of **the variables relate to the patients' circumstances** (e.g. smokers versus non-smokers) and other variables to the **characteristics of the implant device.**

The program contains approximately 200 potential inputs for every implant. According to the testimony, Dr. Arlin uses about 50 of these. Currently he has records for approximately 12,000 implants.

Dr. Arlin believes that by studying this data he can provide a useful addition to scientific knowledge.

Dr. Arlin estimated that he spent 350 hours per year on SR&ED since Fridays were spent on research when he does not see patients.

Evidence of experimentation or analysis

Dr. Arlin testified that he updated his research for all of his lectures.

The judge also noted that;

a) this testimony was very brief

b) should have provided greater detail and documentary support &
c) many of the **lectures** were
- not given to implant specialists &
- had a **marketing component**.

Issue(s):

1) whether there was systematic investigation &
2) whether the allocation of Dr. Arlin's time was reasonable.

Relevant legislation and analysis:

A significant focus at the hearing was on the requirement of "systematic investigation" in the definition of SR&ED[3] in Income Tax Act.

The CRA argued the research is not sufficiently documented to qualify as "systematic investigation" since;

a) Dr. Arlin "failed to develop specific **hypotheses prior to the data collection &**

b) there is **insufficient evidence of time spent** by Dr. Arlin on research in the relevant years.

Ruling & rationale: loss due to lack of documentation

The judge;

a) was "reluctant to agree with" the requirement for "hypotheses [to be] determined prior to the data collection" however,

b) "the main problem … very little detailed evidence regarding the analysis done in the years at issue and the time spent."

She stated that,

> "the Tritan program is designed to present comparative tables at the press of a button. The actual time spent on applied research potentially might be very small….
>
> In order to support the appellant's claims, the evidence as to actual research done, and the amount of time spent, would have to be much more detailed."

[1] Tax Court of Canada website [www.tcc-cci.gc.ca]
[2] Murray Arlin Dentistry Professional Corporation v. The Queen - Tax Court of Canada, 2012 TCC 133, Informal procedure
[3] Income Tax Act subsection 248(1)

Implications and author's commentary

Though the judge did not require pre-stated hypotheses these might have helped the situation as far as relevant evidence.

The biggest disappointment in this case was the claimant's inability to provide any real evidence of experimentation or analysis.

We are told they provided a single research article which was published in 2007 in order to support claims for the 2007 and 2008 taxation years. Clearly the 2007 article could NOT have dealt with the 2008 work and perhaps not even 2007 work.

Results vs. Conclusions:

Basically Dr. Arlin's system was able to illustrate "what" happened however he did not appear to have any written evidence attempting to document;

Why these results occurred &

How any conclusions were formulated.

Evidence examples

The following list illustrates the types of evidence which are typically used to substantiate these types of claims. If Dr. Arlin had provided any of these they would have been excellent supporting documentation.

Notebooks – dated daily with brief, **point form notes of hypotheses, related analysis & time spent**

Emails – correspondence with the suppliers & colleagues regarding any hypotheses & analysis.

Test Reports – any queries from the Tritan system which were used to analyze hypotheses.

Defining the SR&ED hypotheses

This is probably one of the most important and misunderstood sections of the SR&ED process.

To address this issue further in the next section we have outlined some of the key issues and opportunities in defining the "hypotheses for SR&ED purposes."

Notable quote:

"The general advice concerning statistics is, figures never lie, but liars figure"

-Anonymous

What is a "hypotheses" for SR&ED

Null hypothesis[4]

The practice of science involves formulating and testing hypotheses, assertions that are capable of being proven false using a test of observed data.

The null hypothesis typically corresponds to a general or default position. For example, the null hypothesis might be that there is no relationship between two measured phenomena or that a potential treatment has no effect.

The term was originally coined by English geneticist and statistician Ronald Fisher in 1935. It is typically paired with a second hypothesis, the alternative hypothesis, which asserts a particular relationship between the phenomena.

Principle

Hypothesis testing works by collecting data and measuring how likely the particular set of data is, assuming the null hypothesis is true.

For instance, a certain drug may reduce the chance of having a heart attack. Possible null hypotheses are

> "this drug does not reduce the chances of having a heart attack" or
>
> "this drug has no effect on the chances of having a heart attack".

The test of the hypothesis consists of administering the drug to half of the people in a study group as a controlled experiment.

If the data show a statistically significant change in the people receiving the drug, the null hypothesis is rejected.

Testing for differences

In scientific and medical research, null hypotheses play a major role in testing the significance of differences in treatment and control groups.

The typical null hypothesis at the outset of the experiment is that no difference exists between the control and experimental groups (for the variable being compared). Other possibilities include:

- that values in samples from a given population can be modeled using a certain family of statistical distributions.
- that the variability of data in different groups is the same, although they may be centered around different values.

Example

Given the test scores of two random samples of men and women, does one group differ from the other? A possible null hypothesis is that the mean male score is the same as the mean female score:

$$H_0: \mu_1 = \mu_2$$

where:

H_0 = the null hypothesis
μ_1 = the mean of population 1, and
μ_2 = the mean of population 2.

A stronger null hypothesis is that the two samples are drawn from the same population, such that the variance and shape of the distributions are also equal.

A **one-tailed hypothesis** is a hypothesis in which the value of a parameter is specified as being either:

- above a certain value, or
- below a certain value.

An example of a one-tailed null hypothesis would be that, in a medical context, an existing treatment, A, is no worse than a new treatment, B.

The corresponding alternative hypothesis would be that B is better than A. Here if the null hypothesis were accepted (i.e. there is no reason to reject the hypothesis that A is at least as good as B), the conclusion would be that treatment A should continue to be used.

If the null hypothesis were rejected, the result would be that treatment B would used in future, given that there is evidence that it is better than A.

A hypothesis test would look for evidence that B is better than A, not for evidence that the outcomes of treatments A and B are different.

Formulating the hypothesis as a "better than" comparison is said to give the hypothesis **directionality**.

[4] From Wikipedia, the free encyclopedia

Directionality

Quite often statements of point null hypotheses appear not to have a "directionality", namely, that values larger or smaller than a hypothesized value are conceptually identical.

However, null hypotheses can and do have "direction"—in many instances statistical theory allows the formulation of the test procedure to be simplified, thus the test is equivalent to testing for an exact identity.

For instance, when formulating a one-tailed alternative hypothesis, *application of Drug A will lead to increased growth in patients*, then the true null hypothesis is the opposite of the alternative hypothesis, i.e. *application of Drug A will not lead to increased growth in patients* (a composite null hypothesis).

The effective null hypothesis will be *application of Drug A will have no effect on growth in patients* (a point null hypothesis).

The testing process[5]

In the statistical literature, statistical hypothesis testing plays a fundamental role.[8][*citation needed*]

The **usual line of reasoning** is as follows:

1. There is an initial research hypothesis of which the truth is unknown.

2. The first step is to state the relevant **null and alternative hypotheses**. Specifically, the null hypothesis allows to attach an attribute: it should be chosen in such a way that it allows us to conclude whether the alternative hypothesis can either be accepted or stays undecided as it was before the test.

3. The second step is to consider the statistical assumptions being made about the sample in doing the test; for example, assumptions about the statistical independence or about the form of the distributions of the observations.

4. Decide which test is appropriate, and state the relevant **test statistic** *T*. – SEE DETAILS ON NEXT PAGE

5. Derive the distribution of the test statistic under the null hypothesis from the assumptions. In standard cases this will be a well-known result.

For example the test statistic may follow a Student's t distribution or a normal distribution.

6. The distribution of the test statistic partitions the possible values of *T* into those for which the null hypothesis is rejected, the so called critical region, and those for which it is not.

7. Compute from the observations the observed value *t*obs of the test statistic *T*.

8. Decide to either **fail to reject** the null hypothesis or **reject** it in favor of the alternative.

The decision rule is to reject the null hypothesis *H*0 if the observed value *t*obs is in the critical region, and to accept or "fail to reject" the hypothesis otherwise.

An **alternative process** is commonly used:

6. Select a significance level (α), a probability threshold below which the null hypothesis will be rejected. Common values are 5% and 1%.

7. Compute from the observations the observed value *t*obs of the test statistic *T*.

8. From the statistic calculate a probability of the observation under the null hypothesis (the p-value).

9. Reject the null hypothesis or not. The decision rule is to reject the null hypothesis if and only if the p-value is less than the significance level (the selected probability) threshold.

Choice of testing process

The two processes are equivalent. The former process was advantageous in the past when only tables of test statistics at common probability thresholds were available. It allowed a decision to be made without the calculation of a probability. It was adequate for classwork and for operational use, but it was deficient for reporting results.

The latter process relied on extensive tables or on computational support not always available. The explicit calculation of a probability is useful for reporting. The calculations are now trivially performed with appropriate software.

[5] Statistical hypothesis testing - Wikipedia, the free encyclopedia Page 5 of 22
http://en.wikipedia.org/wiki/Statistical_hypothesis_testing 5/28/2012

Common test statistics

In order to address the null hypotheses a series of analytical methods are applicable:

One-sample tests are appropriate when a sample is being compared to the population from a hypothesis. The population characteristics are known from theory or are calculated from the population.

Two-sample tests are appropriate for comparing two samples, typically experimental and control samples from a scientifically controlled experiment.

Paired tests are appropriate for comparing two samples where it is impossible to control important variables. Rather than comparing two sets, members are paired between samples so the difference between the members becomes the sample. Typically the mean of the differences is then compared to zero.

Z-tests are appropriate for comparing means under stringent conditions regarding normality and a known standard deviation.

T-tests are appropriate for comparing means under relaxed conditions (less is assumed).

Tests of proportions are analogous to tests of means (the 50% proportion).

Chi-squared tests use the same calculations and the same probability distribution for different applications:

- Chi-squared tests for **variance** are used to determine whether a normal population has a specified variance. The null hypothesis is that it does.
- Chi-squared tests of **independence** are used for deciding whether two variables are associated or are independent.
- Chi-squared **goodness of fit** tests are used to determine the adequacy of curves fit to data. The null hypothesis is that the curve fit is adequate.

F-tests (analysis of variance, ANOVA) are commonly used when deciding whether groupings of data by category are meaningful. If the variance of test scores of the left-handed in a class is much smaller than the variance of the whole class, then it may be useful to study lefties as a group. The null hypothesis is that two variances are the same - so the proposed grouping is not meaningful.

Sample size

Statistical hypothesis testing involves performing the same experiment on multiple subjects. The number of subjects is known as the sample size. The properties of the procedure depends on the sample size.

Even if a null hypothesis does not hold for the population, an insufficient sample size may prevent its rejection. If sample size is under a researcher's control, a good choice depends on

- the statistical power of the test,
- the effect size that the test must reveal and
- the desired significance level.

The statistical power is the probability of rejecting the null hypothesis when it does not hold in the population (i.e., for a particular effect size).

The significance level is the probability of rejecting the null hypothesis when the null hypothesis holds in the population.

According to published theory, "**Generally fewer than 30 trials puts any conclusion at risk.**"

Further issues in health science studies

Biostats uses basic statistics only as a foundation.

Biological variability results in developing stats applications well beyond those that have been listed & generally requires advice from a biostats practitioner.

Each study has to tailor its stats tools to the overall objectives & intended approach of the study (e.g.,

- different applications/premises used to identify
- causal agents affecting health in epidemiology vs.
- determining potential health outcomes in treatment studies, etc.).

then study specific objectives including,

- calculation of adequate population size,
- methodology (inclusion/exclusion criteria, type & number of biomarkers, cohort assignment, etc.) &
- statistical analyses methods which are inextricably linked.

A study protocol that incorporates all these facets prior to embarking on data collection is a key component of an eligible study.

Arlin case revisited– application of null hypotheses

Based on the facts as provided it appears Dr. Arlin may have required a null hypothesis to use as the basis for:

> Each set of circumstances/conditions that would potentially influence success/no-success (smoker / non-smoker / diabetic / immuno-compromised /plaque profile /etc.);
>
> Each condition would represent a different cohort and inclusion/exclusion criteria need to be specified;
>
> Outline statistical analyses for data with associated calculation of target population size (would need to identify a control for comparative purposes for each cohort);

Ongoing data development is SR&ED eligible, so annual reviews of data/trends necessary to maintain continuity and demonstrate analysis.

The above represents demonstration of systematic approach flowing from the null hypotheses, then

- time can be allocated by patient enrollment/visitations
- within any given year specific to intervention requirements including;
  - dentist /assistant for data collection &
  - annual analysis review).

Much of this would be present in the patient records, it's the ongoing analyses that are key.

Author's note:

Records relating to of any of these tests would be strong evidence of SR&ED.

As previously noted, had Dr. Arlin produced such records he would likely have been successful in his claim.

2012 Provincial SR&ED updates

So far the provincial budgets have been released for BC, Saskatchewan, Manitoba, Ontario & Quebec.

The only significant provincial changes to the SR&ED Tax Credit

Manitoba

> The Manitoba SR&ED tax credit (ITC) rate remains 20%; however the budget provides a reminder that starting 2012 the refundable portion of the ITC will be 10% (up from 5% in 2011).

Saskatchewan

> Saskatchewan introduced measures to make the province's Research and Development Tax Credit non-refundable, except for certain Canadian-controlled private corporations (CCPCs);
>
> Currently, Saskatchewan provides a 15% refundable Research and Development (R&D) Tax Credit for all corporations.
>
> For R&D expenditures incurred after March 31, 2012:
>
> - a 15% refundable R&D tax credit can be claimed by CCPCs on up to $3 million of qualifying expenditures annually; and
> - a 15% non-refundable credit can be claimed on qualifying expenditures incurred by: CCPCs exceeding the above limit and other corporations.

Questions or feedback

We welcome your questions or feedback on any issues raised in this letter.

We also encourage interested parties to examine:

- past SR&ED newsletters
- SR&ED tax guide,
- "RDBASE.CA" online SR&ED tracking software &
- additional tutorials re. eligible SR&ED activities at

www.rdbase.ca

Terms of use

Although we endeavor to ensure accurate & timely information throughout this letter, it is not intended to be a definitive analysis of the legislation, nor a substitute for professional advice.

Before implementing decisions based on this information, readers are encouraged to seek professional advice, in order to clarify how any issues discussed herein, may relate to their specific situations.