

Comparison of wood used by major 18th century violin makers from Italy

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Using statistical and diagrammatic methods from the research using dendrochronology, comparisons of the results can be made between the samples of wood used by a variety of violin makers. Comparisons can be made with instruments by the same maker and they themselves can then be compared against other makers with the same nationality and still other makers from different countries. With knowing the dendrochronological dates of the wood, such comparisons can lead to an insight into the possible working practices of the early makers which itself can lead to establishing the likely manufacture date of instruments should obvious dating evidence, such as labels, inscriptions or documentary evidence, is unavailable. I shall use evidence taken from the violins of Antonio Stradivari, for which I can use up to one hundred samples, of Guarneri del Gesù and J.B. Guadagnini. Dendrochronology can only provide the date of the youngest ring present on wood used in each instrument and can not directly give distinct evidence for the dating on a manufactured instrument, but by applying knowledge of the working practices of present violin maker, much intelligent speculation can be attempted.

The dating of the manufacture of violins using dendrochronology cannot ever be precise. Research shows that makers never used wood that always had a precise seasoning time. (Topham & McCormick, 1998, 2000). There is a tendency with instruments by some makers, particularly with Antonio Stradivari, where a certain time interval does occur between the most recent dendrochronological date and either the label date or the expert's attribution of the likely manufacture date. In Antonio Stradivari's case, an interval of about ten years is common. However in many other cases, including other instruments by Stradivari, the difference between the dendrochronological dates and the attributed manufacture dates vary considerably.

Had a particular consistent interval of time been used between the time the tree was felled and the manufacture date of the instrument, the dating of the time of manufacture of the violin based on the most recent dendrochronological date would be a very simple matter. However as this time interval varies unpredictably, attempting to date the making of the instrument would appear to be a fruitless task. However, by gathering data from many instruments known to have been made by the same maker, a way to date undated instruments by that maker or by other makers may be possible.

Recent research has been published concerning the relationship between the fronts of 60 violins by Antonio Stradivari (The Strad, 2007). A diagram was published showing a *t*-value matrix, and colour coded for ease of observation, showing statistical relationships between all the fronts (Diagram 1).

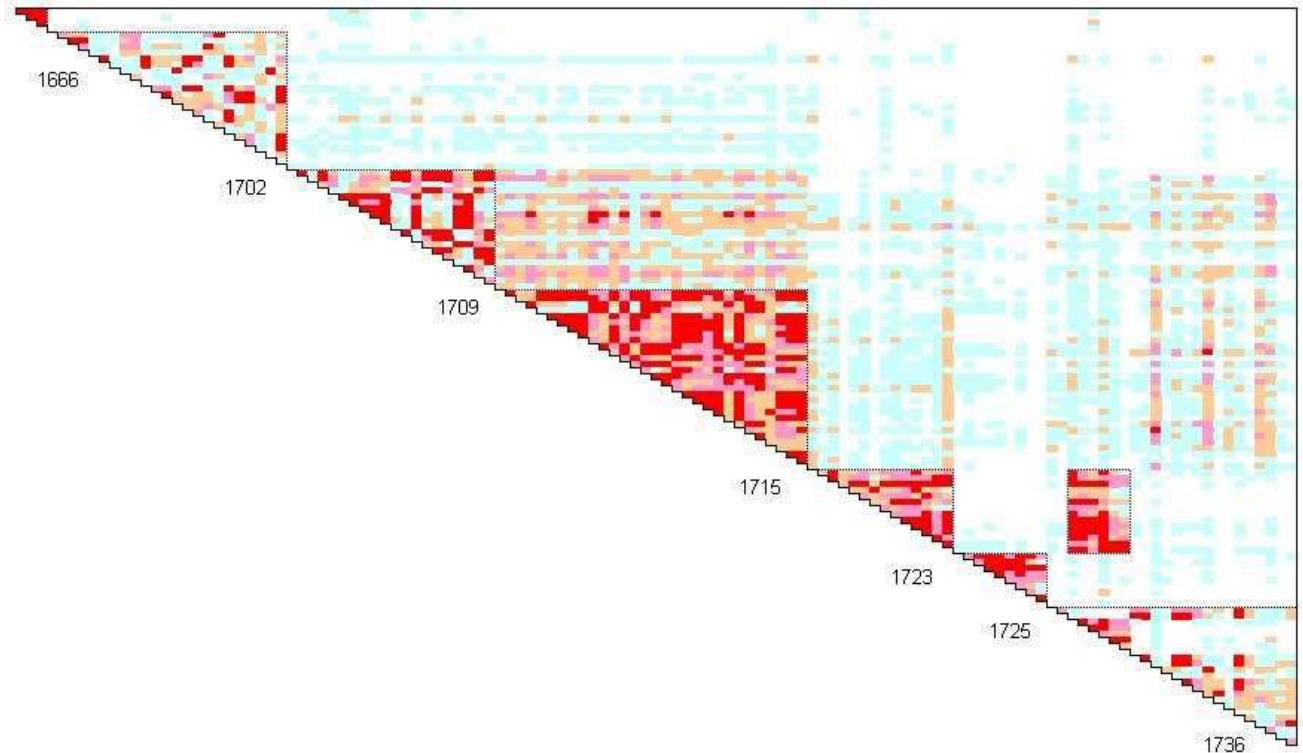


Diagram 1: Schematic representation of a matrix of t -values taken from violins made by Antonio Stradivari (Courtesy of The Strad Magazine).

In the diagram the stronger colours represented the higher t -values. In this case the dark red showed the highest t -values, and the light blue showed the lowest significant t -values. It was observed that the wood used by Stradivari appeared to be separated into discreet groups related to certain time periods. The diagram loosely identified six time groups. Although there were sections that overlapped suggesting certain similarities, on the whole the diagram suggested that over time Stradivari used distinct types of wood for the fronts of his instruments in particular time periods. By using the information and data that made up this diagram it is possible to pinpoint a possible manufacture date for an unknown instrument.

This can be highlighted with two particularly interesting examples. A violin was shown to an auction house this year. It had an Antonio Stradivari label but the date had been erased over time, although the rest of the label did have strong Stradivari characteristics. The back, ribs and head of the instrument were also convincing as Stradivari's work, however the front was less convincing. A dendrochronological analysis was carried out on the front of the instrument and very clear dendrochronological dates were obtained. The front was made of two pieces which are termed the bass and treble sides. The dates of the youngest rings on the bass and treble sides came to 1690 and 1702 respectively.

As an initial assessment it is clear that the instrument can not have been made before 1702. As Stradivari is attributed to have died in 1737 we therefore have been able to narrow the time this instrument could have been made, or at least the front, to an interval of 35 years.

Based on previous research with a lot of Stradivari's instruments where an interval of ten years between the dendrochronological dates and the attributed manufacture date is common, one could make a judgement of the age of this unknown instrument by adding ten years to the latest dendrochronological date, in this bringing the date to 1712. However this still relies on speculation and no real evidence supports this assumption. If you are dealing with very valuable instrument, where the value of the instrument can be highly influenced by time it was made, such unsupported assumptions are not convincing enough.

However taking the data from the instrument under study and comparing its data with data from other Stradivari instruments allows us to see a pattern which may provide the evidence to support a possible manufacture date. Table 1 shows the cross-matching of all Stradivari data against both sides of the aforementioned undated Stradivari violin. Coloured bars have been added to graphically show the strength of the matching statistic. As can be seen the highest values appear to occur with instrument from the 1711-1716 period. Referring to diagram 1 the 1711-1716 period does appear to constitute a distinct group which suggests the wood in that period have common characteristics which relates to either a possible common growing location shared by the trees from which the wood came or possibly to the wood coming the same tree.

Table 1

Name	Date	Side	Bass	f -values	Treb
-	1666	Bass	2.3		ns
-	1666	Treble	2.0		0.7
Askby	1666	Bass	2.0		ns
-	1666	Treble	2.4		ns
-	1667	Whole	ns		ns
-	1670	Treble	3.7		2.3
Suarise	1677	Whole	3.3		ns
-	1679	Bass	ns		ns
-	1679	Treble	ns		ns
Hellier	1679	Bass	ns		ns
-	1679	Treble	0.6		ns
-	1680	Bass	0.7		1.3
Reynaier	1681	Bass	1.6		0.8
-	1681	Treble	1.0		0.7
-	1682	Bass	3.2		2.9
-	1682	Treble	1.3		ns
Cipriani Potter	1683	Bass	2.4		0.6
-	1683	Treble	2.8		1.7
-	1685	Bass	ns		ns
-	1685	Treble	6.0		1.7
-	1685	Bass	2.3		1.3
-	1685	Treble	ns		ns
Auer	1691	Bass	3.0		3.2
-	1691	Treble	2.2		1.7
Ratson	1694	Bass	2.6		2.0
-	1694	Treble	1.8		1.3
Muir-Mackenzie	1694	Bass	5.2		1.8
-	1694	Treble	1.9		0.4
-	1695	Whole	2.4		1.8
Goetz	1695	Bass	4.0		3.0
-	1695	Treble	3.1		1.3
-	1696	Bass	4.1		3.1
-	1696	Treble	1.8		ns
Ries	1698	Bass	4.1		0.8
-	1698	Treble	3.7		2.1
-	1699	Bass	4.4		3.0
-	1699	Treble	4.4		2.7
Ex-Crespi	1699	Bass	2.8		1.4
-	1699	Treble	5.1		1.6
-	1699	Bass	0.9		0.4
-	1699	Treble	ns		ns
Kustendyke	1699	Bass	3.8		2.3
-	1699	Treble	4.5		3.3
Lady Tennant	1699	Bass	4.3		0.9
-	1699	Treble	3.3		2.2
-	1700	Bass	4.7		1.7
-	1700	Treble	4.5		1.9
Marquise	1701	Bass	3.7		1.1
-	1701	Treble	3.4		1.4
Lady Harasworth	1702	Whole	ns		ns
Sauret	1702	Bass	3.1		2.8
-	1702	Treble	2.3		3.4
Ex-Brodsky	1702	Whole	4.5		1.3
-	1703	Bass	3.6		1.0
-	1703	Treble	4.5		6.1
Betts	1704	Bass	2.4		1.3
-	1704	Treble	-		-
Liebig	1704	Bass	2.8		2.8
-	1704	Treble	3.3		3.0

Name	Date	Side	Bass	f -values	Treb
-	1707	Bass	6.6		4.4
-	1707	Treble	7.0		5.4
Hammer	1707	Bass	2.8		2.8
-	1707	Treble	2.9		2.0
Davidoff	1708	Bass	6.6		6.2
-	1708	Treble	5.9		3.9
Tea	1708	Bass	6.7		7.6
-	1708	Treble	5.9		5.3
Ex-Regat	1708	Bass	6.6		8.6
-	1708	Treble	7.8		8.0
-	1708	Bass	6.9		6.9
-	1708	Treble	7.3		8.5
-	1708	Bass	5.7		1.7
-	1708	Treble	5.1		1.7
Havemeyer	1708	Bass	6.0		9.6
-	1708	Treble	6.5		4.5
La Pecelle	1709	Bass	7.2		3.5
-	1709	Treble	6.0		2.9
-	1709	Bass	7.5		8.8
-	1709	Treble	8.6		3.2
Viotti	1709	Bass	6.3		5.2
-	1709	Treble	6.6		3.2
Campo Felice	1710	Bass	6.5		4.3
-	1710	Treble	6.5		1.9
Parke	1711	Bass	13.0		5.5
-	1711	Treble	3.1		4.7
-	1711	Bass	7.8		5.4
-	1711	Treble	7.6		6.1
-	1711	Bass	6.5		3.1
-	1711	Treble	3.4		3.2
Fountainie	1712	Bass	7.5		12.2
-	1712	Treble	7.4		17.5
Le Brun	1712	Bass	11.0		4.2
-	1712	Treble	16.0		5.3
Gibson-Huberman	1713	Bass	10.3		4.3
-	1713	Treble	10.8		4.4
Baron d'Assignies	1713	Bass	3.5		5.1
-	1713	Treble	3.0		6.0
Wirth	1713	Bass	8.0		8.3
-	1713	Treble	3.0		3.5
Piagrille	1713	Bass	9.3		6.2
-	1713	Treble	8.3		3.3
Dolphin	1714	Bass	9.8		7.1
-	1714	Treble	8.0		7.3
General Kyd	1714	Bass	7.6		6.4
-	1714	Treble	12.0		4.6
Langbein	1714	Bass	11.8		4.0
-	1714	Treble	11.8		4.7
Camilloni?	1715	Bass	6.4		4.1
-	1715	Treble	5.8		3.2
Marsik	1715	Bass	15.8		7.1
-	1715	Treble	12.1		4.7
-	1715	Bass	7.2		7.4
-	1715	Treble	12.9		6.2
Baron Knoop	1715	Bass	6.6		16.8
-	1715	Treble	7.9		7.2
-	1715	Bass	6.4		11.3
-	1715	Treble	3.5		5.7

Table 1: Statistical comparison of data from 1st violin under study with data from other Stradivari violins.

Table 1 (continued)

Name	Date	Side	Bass	f -valuez	Treb
Ex De Barrow	1715	Bass	8.4		5.0
	1715	Treble	3.0		5.4
Messiah	1716	Bass	3.6		1.8
	1716	Treble	2.5		2.3
Milstein	1716	Bass	4.4		3.2
	1716	Treble	4.0		4.1
Provigay	1716	Bass	3.2		6.3
	1716	Treble	7.8		5.2
Booth	1716	Bass	2.3		5.1
	1716	Treble	3.0		5.0
-	1716	Bass	2.3		5.0
	1716	Treble	3.8		4.8
de Derasty	1716	Bass	3.5		3.8
	1716	Treble	10.1		5.5
Ex-Machez	1716	Bass	4.7		6.3
	1716	Treble	6.3		3.5
Medici	1716	Bass	5.4		3.8
	1716	Treble	3.7		2.3
Cessol	1716	Bass	7.4		4.4
	1716	Treble	6.5		2.7
-	1717	Bass	2.5		2.6
	1717	Treble	2.3		3.0
Sasserao	1717	Bass	1.1		1.8
	1717	Treble	2.1		0.8
Park	1717	Bass	2.1		3.0
	1717	Treble	0.9		1.8
-	1717	Bass	5.7		4.4
	1717	Treble	4.9		4.3
Maurin	1718	Bass	5.8		3.1
	1718	Treble	6.0		2.7
alvatori Accardo	1718	Bass	4.8		4.4
	1718	Treble	4.6		4.5
-	1718	Bass	3.0		4.3
	1718	Treble	14.0		5.8
Alba Herzog	1719	Bass	6.0		4.0
	1719	Treble	3.7		4.6
-	1719	Bass	4.7		5.0
	1719	Treble	3.1		4.6
Ex Beckerath	1720	Bass	4.3		2.8
	1720	Treble	2.8		3.5
-	1720	Bass	4.6		5.2
	1720	Treble	2.8		4.9
-	1721	Bass	5.1		4.4
	1721	Treble	2.2		4.4
Lady Blunt	1721	Bass	4.1		3.8
	1721	Treble	2.5		3.5
Prof Lutz 1	1721	Bass	4.0		3.4
	1721	Treble	4.3		4.2
-	1722	Bass	2.5		4.1
	1722	Treble	4.5		3.2
ate de Chaponay	1722	Bass	4.5		4.4
	1722	Treble	3.9		4.8
-	1723	Bass	5.1		5.4
	1723	Treble	3.4		3.1
Emilianai	1723	Bass	4.6		3.3
	1723	Treble	7.0		5.0
Sarasate	1724	Bass	2.0		3.1
	1724	Treble	3.5		3.6
-	1724	Bass	2.7		3.2

Name	Date	Side	Bass	f -valuez	Treb
-	1724	Bass	2.6		2.6
	1724	Treble	2.5		3.0
Abergaveany	1724	Bass	1.3		1.4
	1724	Treble	2.9		2.7
-	1724	Pc	n/s		4.6
	1724	Pc	n/s		1.8
Ex-Wilhelms	1724	Treble	3.0		4.7
	1724	Bass	6.1		8.1
Chaconac	1725	Bass	1.0		1.5
	1725	Treble	1.5		2.1
-	1726	Bass	4.0		6.8
	1726	Treble	2.6		6.0
Vesarius	1727	Bass	5.4		5.2
	1727	Treble	3.9		3.5
-	1727	Bass	4.8		4.8
	1727	Treble	5.9		6.4
di Barbaro	1727	Bass	3.5		4.0
	1727	Treble	5.8		5.3
-	1727	Bass	3.7		5.9
	1727	Treble	7.3		4.5
-	1729	Bass	5.7		5.7
	1729	Treble	4.1		6.2
-	1729	Bass	5.9		6.6
	1729	Treble	5.4		6.2
-	1730	Bass	3.9		11.2
	1730	Treble	8.6		7.9
Prof. Lutz 2	1730	Bass	5.1		4.3
	1730	Treble	3.5		4.5
-	1730	Bass	6.8		10.4
	1730	Treble	5.2		14.1
Tartini	1731	Bass	2.8		5.5
	1731	Treble	3.4		6.6
-	1732	Bass	8.4		5.7
	1732	Treble	2.9		5.7
Baillot	1732	Bass	5.0		3.7
	1732	Treble	4.2		4.4
Hanna	1733	Bass	4.2		7.6
	1733	Treble	3.3		5.1
Pr. Khevenhuller	1733	Bass	3.8		8.7
	1733	Treble	7.7		5.8
Meushin	1733	Bass	2.6		8.2
	1733	Treble	7.4		6.0
Sassoon	1733	Bass	3.3		6.8
	1733	Treble	3.8		4.5
Habeneck	1734	Bass	8.1		5.7
	1734	Treble	7.2		9.0
Mentz	1736	Bass	2.7		4.2
	1736	Treble	3.4		5.6

Table 1: Statistical comparison of data from 1st violin under study with data from other Stradivari violins.

By the high statistical values shown, in this case, it is possible that the pieces from the violins listed and the violin under study may have come from the same tree. This is only likely to have happened if Stradivari was making the instruments at the same time allowing us to ascertain that the date of manufacture of the front to around 1711/16. On reflection the previous assumption of 1712 might not have been far wrong. However in this case we now have convincing evidence that the 1712 assessment may be right.

In another instrument a London dealer came across a violin also thought to be made by Stradivari but with a 1726 label. No-one was convinced of label date and the look of the label strongly suggested it was a replacement. Previous assessments by other dealers had suggested it was made in the early 1700s. However the London dealer was convinced that the instrument was made in the 1715 period but was unable to be completely sure. I carried out an analysis which also showed clear cross-matching results giving youngest dates for the bass and treble sides as 1703 and 1706 respectively. Table 2 shows the results of the cross-matching of data from that violin with other known Stradivari violins present in my database. Here again it can be seen that the instruments that most significantly cross-match the 1726 labelled instrument

are again from this 1711/16 period. In that respect the London dealer appears to have been right with his assumption.

Table 2

Name	Date	Side	Bass	f-values	Treb
-	1666	Bass	ns	-	-
-	1666	Treble	ns	-	0.1
Askby	1666	Bass	ns	-	0.7
-	1666	Treble	ns	-	-
-	1667	Whole	ns	-	-
-	1670	Treble	0.4	-	0.7
Suarize	1677	Whole	ns	-	0.9
-	1679	Bass	ns	-	ns
-	1679	Treble	ns	-	ns
Hellier	1679	Bass	ns	-	ns
-	1679	Treble	ns	-	-
-	1680	Bass	0.7	-	0.4
Reynier	1681	Bass	2.5	-	1.2
-	1681	Treble	1.9	-	0.7
-	1682	Bass	0.0	-	1.5
-	1682	Treble	ns	-	0.4
Cipriani Potter	1683	Bass	-	-	-
-	1683	Treble	1.7	-	0.1
-	1685	Bass	ns	-	ns
-	1685	Treble	0.7	-	1.5
-	1685	Bass	0.9	-	1.7
-	1685	Treble	ns	-	ns
Awer	1691	Bass	0.5	-	-
-	1691	Treble	-	-	0.2
Ratson	1694	Bass	3.3	-	2.8
-	1694	Treble	2.9	-	-
Muir-Mackenzie	1694	Bass	2.6	-	1.8
-	1694	Treble	0.3	-	0.9
-	1695	Whole	1.0	-	1.0
Goetz	1695	Bass	-	-	1.1
-	1695	Treble	-	-	1.2
-	1696	Bass	-	-	0.3
-	1696	Treble	ns	-	ns
Ries	1698	Bass	1.4	-	2.4
-	1698	Treble	2.6	-	2.5
-	1699	Bass	2.8	-	2.1
-	1699	Treble	0.5	-	1.6
Ex-Crespi	1699	Bass	0.7	-	1.4
-	1699	Treble	2.1	-	2.5
-	1699	Bass	1.1	-	0.1
-	1699	Treble	-	-	1.2
Kustendyke	1699	Bass	-	-	0.4
-	1699	Treble	1.1	-	1.4
Lady Tennant	1699	Bass	3.6	-	1.6
-	1699	Treble	2.8	-	1.5
-	1700	Bass	3.3	-	2.4
-	1700	Treble	0.4	-	0.8
Marquise	1701	Bass	1.4	-	2.4
-	1701	Treble	0.0	-	1.3
Lady Harasworth	1702	Whole	ns	-	ns
Sauret	1702	Bass	2.1	-	2.3
-	1702	Treble	2.5	-	3.2
Ex-Brodsky	1702	Whole	2.7	-	2.0
-	1703	Bass	5.4	-	4.2
-	1703	Treble	4.2	-	4.0
Betts	1704	Bass	0.3	-	1.5
-	1704	Treble	-	-	-
Liebig	1704	Bass	2.0	-	1.7
-	1704	Treble	1.4	-	1.0

Name	Date	Side	Bass	f-values	Treb
-	1707	Bass	3.1	-	3.0
-	1707	Treble	4.8	-	3.7
Hammer	1707	Bass	4.1	-	2.0
-	1707	Treble	2.9	-	2.1
Davidoff	1708	Bass	2.8	-	2.5
-	1708	Treble	3.2	-	3.0
Tea	1708	Bass	5.6	-	3.6
-	1708	Treble	2.4	-	1.2
Ex-Regent	1708	Bass	5.3	-	2.7
-	1708	Treble	6.4	-	3.4
-	1708	Bass	5.9	-	2.9
-	1708	Treble	5.1	-	3.3
-	1708	Bass	3.6	-	3.3
-	1708	Treble	1.7	-	2.5
Havemeyer	1708	Bass	5.4	-	3.4
-	1708	Treble	4.1	-	3.3
La Pucelle	1709	Bass	3.6	-	4.0
-	1709	Treble	2.8	-	2.7
-	1709	Bass	5.7	-	3.3
-	1709	Treble	5.7	-	3.2
Viotti	1709	Bass	4.5	-	3.2
-	1709	Treble	2.9	-	3.2
Campo Selice	1710	Bass	1.6	-	2.7
-	1710	Treble	2.0	-	1.7
Parke	1711	Bass	3.9	-	3.2
-	1711	Treble	5.0	-	4.6
-	1711	Bass	5.8	-	3.4
-	1711	Treble	5.6	-	3.0
-	1711	Bass	2.2	-	2.4
-	1711	Treble	3.1	-	-
Fontaine	1712	Bass	4.6	-	4.6
-	1712	Treble	5.4	-	5.5
Le Brun	1712	Bass	4.4	-	4.8
-	1712	Treble	2.5	-	4.8
Gibson-Huberman	1713	Bass	2.9	-	3.6
-	1713	Treble	2.9	-	3.8
Baron d'Assignies	1713	Bass	3.6	-	4.5
-	1713	Treble	6.9	-	3.5
Wirth	1713	Bass	7.6	-	3.7
-	1713	Treble	3.2	-	3.9
Piagrille	1713	Bass	5.6	-	3.7
-	1713	Treble	3.2	-	3.9
Dolphin	1714	Bass	7.2	-	3.8
-	1714	Treble	6.9	-	4.3
General Kyd	1714	Bass	5.8	-	4.1
-	1714	Treble	4.1	-	3.7
Langbein	1714	Bass	3.0	-	3.5
-	1714	Treble	3.9	-	3.3
Camilloni?	1715	Bass	4.2	-	4.2
-	1715	Treble	4.0	-	4.3
Marsik	1715	Bass	4.2	-	6.3
-	1715	Treble	4.5	-	5.0
-	1715	Bass	7.4	-	4.6
-	1715	Treble	4.1	-	3.3
Baron Kaoop	1715	Bass	5.5	-	3.7
-	1715	Treble	3.2	-	3.1
-	1715	Bass	5.8	-	4.4
-	1715	Treble	12.0	-	7.1

Table 2a: Statistical comparison of data from 2nd violin under study with data from other Stradivari violins.

Table 2 (continued)

Name	Date	Side	Bass	t-values	Treb
Ex De Barrou	1715	Bass	6.3		5.1
	1715	Treble	5.1		4.0
Messiah	1716	Bass	3.5		2.4
	1716	Treble	3.0		1.8
Milstein	1716	Bass	6.3		5.6
	1716	Treble	6.5		12.1
Provigny	1716	Bass	7.2		4.5
	1716	Treble	6.3		4.1
Booth	1716	Bass	3.8		7.2
	1716	Treble	3.7		6.5
de Duranty	1716	Bass	4.0		4.4
	1716	Treble	4.6		4.5
Ex-Nachez	1716	Bass	3.2		3.7
	1716	Treble	3.1		3.6
Medici	1716	Bass	2.1		1.5
	1716	Treble	4.3		0.7
Cessol	1716	Bass	4.2		3.4
	1716	Treble	3.2		3.0
-	1717	Bass	2.5		1.4
	1717	Treble	3.1		1.3
Sasserno	1717	Bass	2.0		1.7
	1717	Treble	2.0		1.7
Park	1717	Bass	2.7		2.0
	1717	Treble	1.1		0.9
-	1717	Bass	2.1		2.2
	1717	Treble	3.6		3.7
Mauria	1718	Bass	2.8		2.2
	1718	Treble	2.8		2.1
alvatori Accardo	1718	Bass	5.8		4.0
	1718	Treble	4.4		3.4
-	1718	Bass	3.9		4.3
	1718	Treble	3.2		3.3
Alba Herzog	1719	Bass	3.6		2.3
	1719	Treble	1.8		2.0
-	1719	Bass	4.7		4.7
	1719	Treble	4.4		3.8
Ex Beckerath	1720	Bass	2.4		2.9
	1720	Treble	3.9		3.1
-	1720	Bass	6.0		5.1
	1720	Treble	5.1		3.2
-	1721	Bass	3.4		2.7
	1721	Treble	3.0		1.3
Lady Blunt	1721	Bass	2.1		1.0
	1721	Treble	2.4		-
Prof Lutz 1	1721	Bass	3.1		2.8
	1721	Treble	2.7		2.3
-	1722	Bass	3.0		3.1
	1722	Treble	2.5		1.7
ate de Chaposay	1722	Bass	3.1		2.6
	1722	Treble	3.2		2.6
-	1723	Bass	2.5		2.7
	1723	Treble	2.4		2.2
Emilian	1723	Bass	3.2		2.2
	1723	Treble	3.3		3.2
Sarasate	1724	Bass	5.3		2.4
	1724	Treble	5.0		2.8
-	1724	Bass	5.0		3.0

Name	Date	Side	Bass	t-values	Treb
-	1724	Bass	5.1		2.3
	1724	Treble	5.7		3.2
Abergavenay	1724	Bass	3.5		2.4
	1724	Treble	4.7		1.7
	1724	Pc	5.8		4.3
Ex-Wilhelms	1724	Treble	2.9		2.0
	1724	Bass	5.8		4.0
Chacone	1725	Bass	3.3		1.5
	1725	Treble	4.6		2.4
-	1726	Bass	4.9		3.8
	1726	Treble	4.3		2.6
Vesuvius	1727	Bass	3.3		2.9
	1727	Treble	2.8		3.2
-	1727	Bass	4.8		3.8
	1727	Treble	4.4		4.5
di Barbaro	1727	Bass	3.4		2.7
	1727	Treble	4.2		3.5
-	1727	Bass	2.8		3.7
	1727	Treble	2.7		3.1
-	1729	Bass	4.4		5.0
	1729	Treble	5.7		5.6
-	1729	Bass	5.5		3.8
	1729	Treble	5.8		5.3
-	1730	Bass	4.9		4.9
	1730	Treble	4.2		3.4
Prof. Lutz 2	1730	Bass	3.5		2.8
	1730	Treble	2.6		4.3
-	1730	Bass	6.0		5.5
	1730	Treble	4.4		3.6
Tartini	1731	Bass	3.9		3.4
	1731	Treble	4.3		4.3
-	1732	Bass	6.7		6.6
	1732	Treble	6.4		6.2
Baillot	1732	Bass	5.2		4.2
	1732	Treble	4.5		3.8
Hamma	1733	Bass	4.9		4.5
	1733	Treble	3.4		3.6
Pr. Khevenhuller	1733	Bass	5.1		3.9
	1733	Treble	6.4		6.2
Meuhin	1733	Bass	4.5		3.9
	1733	Treble	3.9		3.3
Sassoon	1733	Bass	4.2		4.1
	1733	Treble	2.1		1.7
Habeneck	1734	Bass	4.1		4.0
	1734	Treble	5.5		4.8
Muntz	1736	Bass	2.3		2.3
	1736	Treble	3.2		2.7

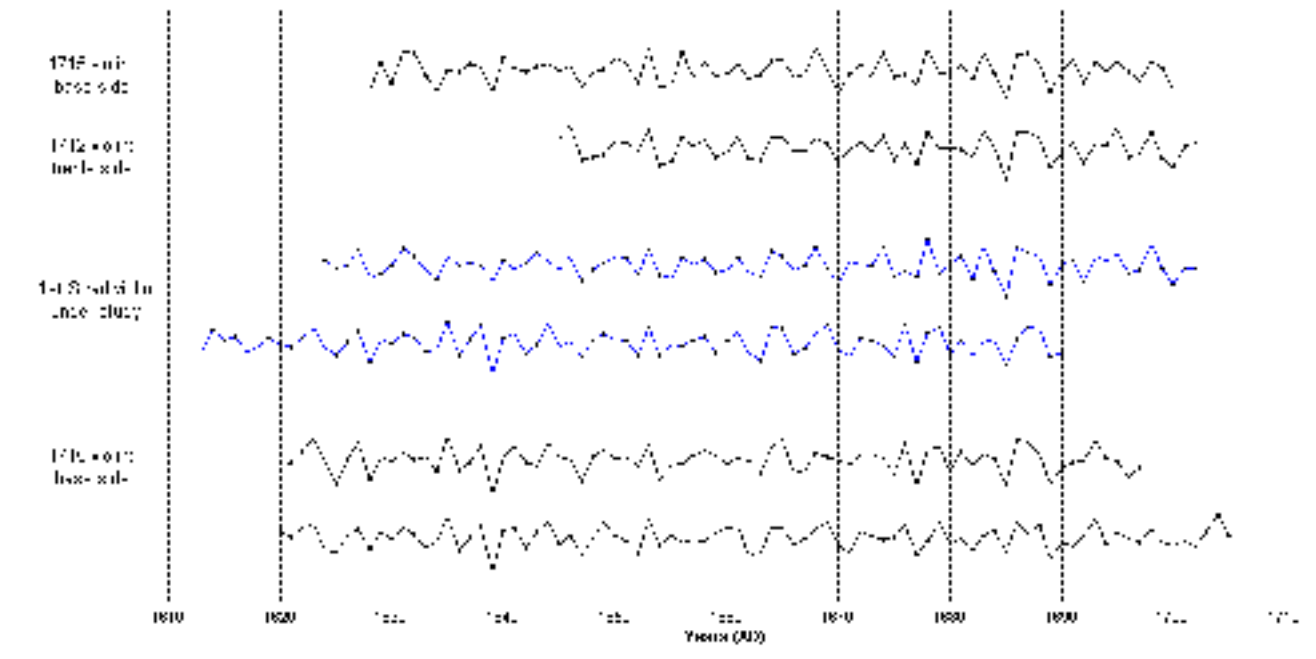
Table 2b: Statistical comparison of data from 2nd violin under study with data from other Stradivari violins.

Referring to graphs of the two violins under study compared with the data taken from some of the fronts that very significantly cross-match the violins (Graph 1 & 2, see page 9), one can see that it is highly likely that the pieces have more in common than just dendrochronological significance and helps corroborate the statistical evidence. For example, as shown on table 1 the bass side of the 1st Stradivari violin cross-matches very significantly with the treble side of the 1712 *Le Brun* violin as well as the bass side of the 1715 *Marsik* violin. With *t*-values of 16.0 and 15.8 respectively it is highly likely these pieces came from the same tree. Similarly the treble side of the 1st violin very significantly cross-matches the treble side of the 1712 *La Fontaine* violin and the bass side of the 1715 *Baron Knoop* violin. Again with *t*-values of 17.5 and 16.8 respectively, it is also likely these pieces came from the same tree.

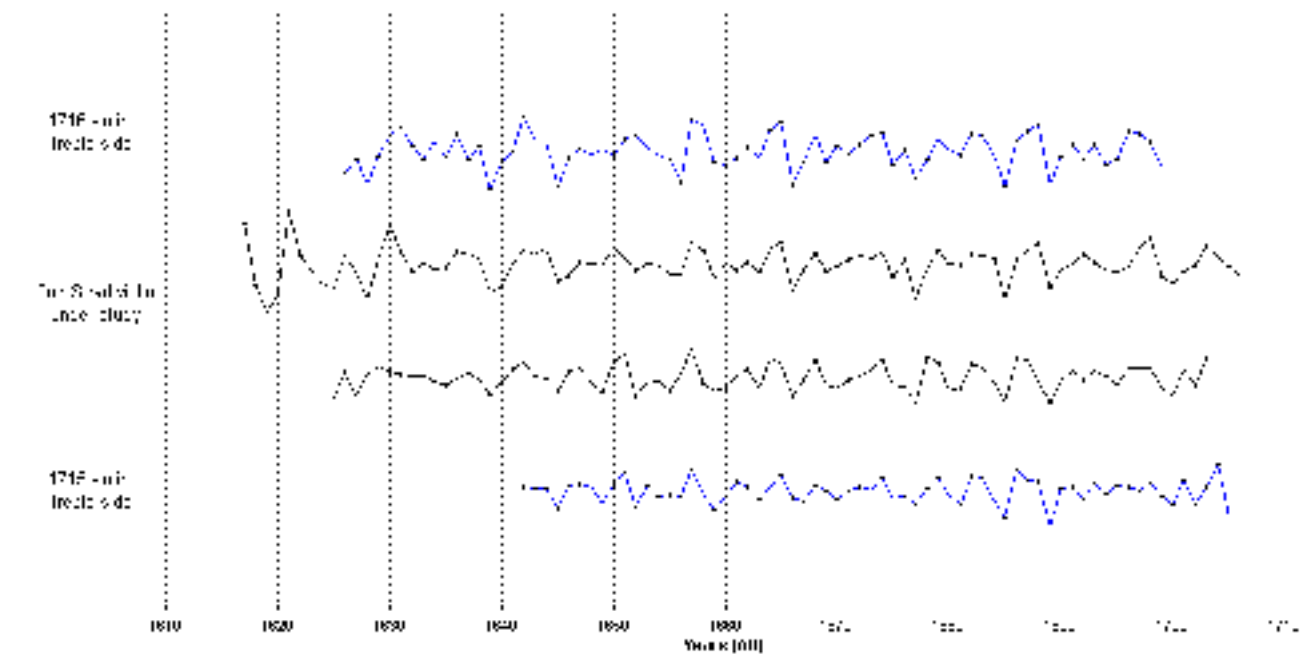
A certain caution has to be observed with this method. As can be seen in both examples the front cross-matches one or two instruments of a later period (See table 1, the bass side of 1st violin compared with treble side of an unnamed 1718 violin and the treble side compared with the treble side of an unnamed 1730 violin) and it is very possible Stradivari used wood that he had kept for a while which he then used on later instruments. This could suggest that the examples shown could have been made later. However when considering the likelihood of a particular manufacture

date, it is likely that if the wood is similar to a lot of others at a particular time then the instrument itself could have been made at the same time.

This method is naturally only able to be used if many examples of a particular maker's work has been recorded and with respect to Stradivari, it is fortunate that so many instruments were available. It is also necessary for the maker to have been disciplined in their working methods. Stradivari has a well deserved reputation for being a disciplined maker and is credited to have laid down dimensional norms that are followed today. His disciplined approach appears to have carried through into his choice of wood allowing us to make judgements as to the age of his instruments without documentary evidence. However such a disciplined approach has not always been the case with other makers. On looking at diagram 2 (see page 10) which shows the relationship of around 30 Guarneri del Gesù violins it can be seen that no such grouping appears to exist. Admittedly the time period is shorter. Guarneri only appears to have made instruments from about 1726 to the time of his death around 1744. This period of only 18 years is short compared to the 71 years that Stradivari is supposed to have worked (with examples of his work thought to have been made in 1666 to instruments made just before the time of his death around 1737). In this respect the 18 years could constitute a group of its own when compared to Stradivari, however nevertheless within that period there appears to be no sub-grouping which would enable anyone to make a more definitive pin-pointing of a date.



Graph 1: Comparison of data from 1st violin under study with data from two other Stradivari violins.



Graph 2: Comparison of data from 2nd violin under study with data from two other Stradivari violins.

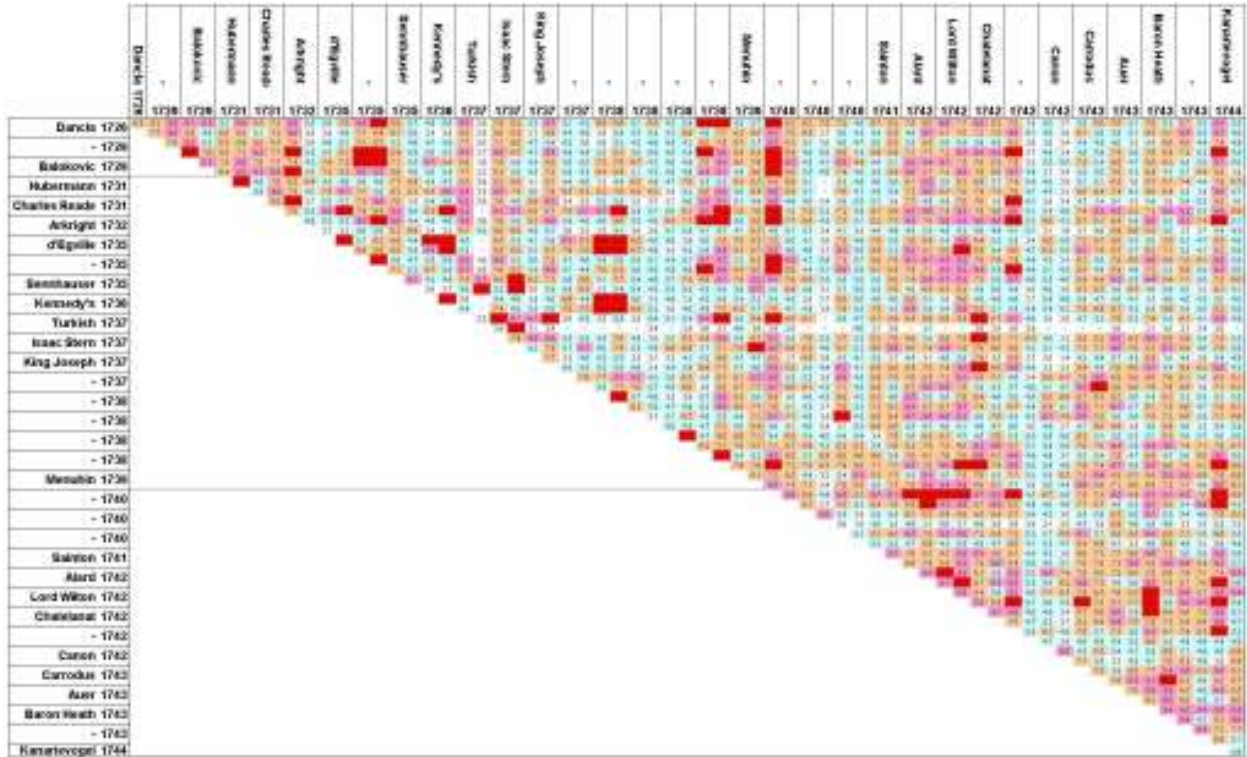


Diagram 2: Matrix of t -values taken from violins by Giuseppe Guarneri del Gesù.

A more promising maker is Giovanni Baptiste Guadagnini. A matrix of the wood (Diagram 3) used by this maker shows a kind of negative grouping in that instruments made by Guadagnini towards the end of his life when he worked in Turin appear not to date very well. The wood used in his earlier period when he worked in Piacenza cross-matches many instruments similar to the way Cremonese and Venetian instruments do. But there is quite a sharp change between those instruments and his later ones. In the case of dating undated instruments by Guadagnini then a distinction between his early and late period could be pin-pointed.

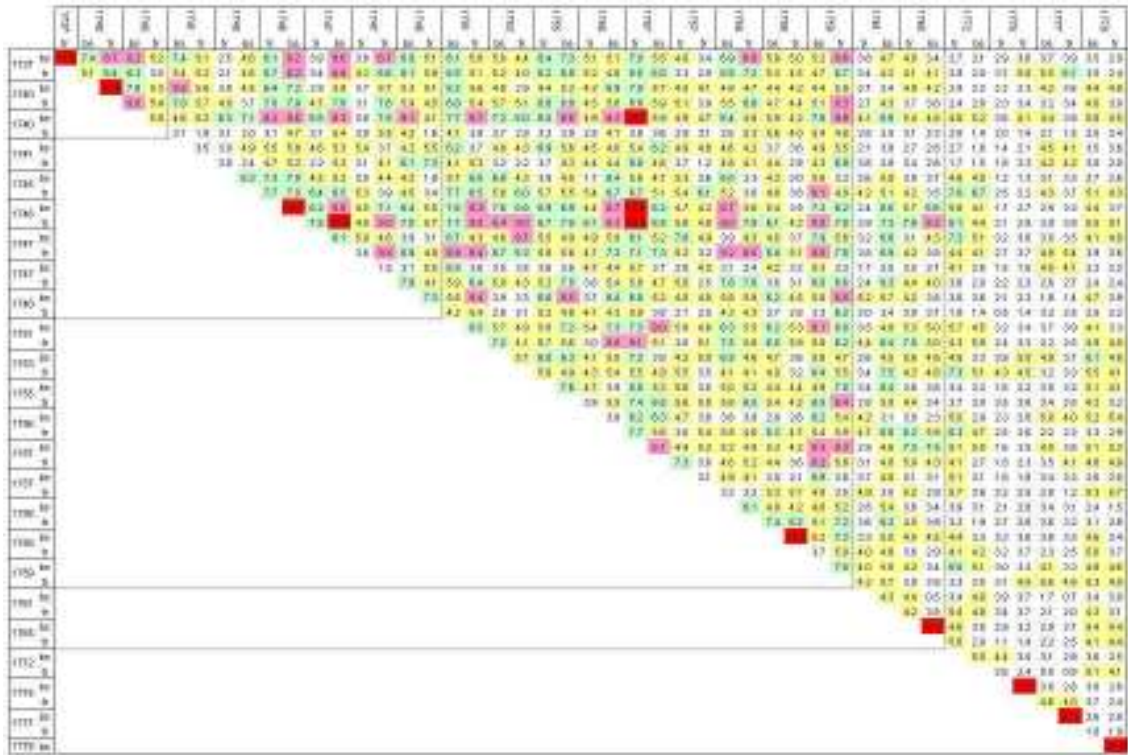


Diagram 3: Matrix of t -values taken from violins by Giovanni Baptiste Guadagnini.

With respect to other makers, such as Jacob Stainer, again a number of instruments from each of these makers have been recorded. Klein & Beuting in their article in a catalogue associated with a Stainer Exhibition provide a matrix of t -values that shows differences over time (Klein & Beuting, 2003). When interpreted to obtain information related to the manufacture dates of the instruments a limited pattern emerges which also could give clues as to types of wood being used in different time periods.

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