***Adam T. Bagwell**, CGCS, MPS*
www.adamtbagwell.com

From the Thick Stuff, April 2012, by Adam Bagwell, CGCS

I haven't tortured Crane Creek members with data analysis for a while, so here it goes…

Since our first survey and green speed analysis in 2008, which found that most members were comfortable with a green speed ranging from 10–10.5 (as measured by a USGA Stimp Meter), the greens staff has continued to collect daily measurements to determine if we are hitting our target speed. We asked ourselves how often did we reach the target? What affected green speed the most? Moisture? Rolling? Mowing height? We haven't answered all the questions to our satisfaction, but I hope you'll be pleasantly surprised by our effort to please the entire membership.

Abstract:

Crane Creek's average green speed was 10.72 from May to October in 2011. With a standard deviation of 1.1, our greens only varied from the average 10.72 by a little over a foot throughout the season. Breaking down average speed by month, in May the average was 9.1, June 10.6, July 11.1, August 10.17, September 11.66, October 11.1. Lower speeds in May and August can be explained by aerification, while the highest month September can be explained by the Boise Open Pro Am Tournament. Looking at the data from a day of the week average, Monday averaged 10.7, Tuesday 10.4, Wednesday 10.8, Thursday 10.3, Friday 10.8, Saturday 10.9, Sunday 10.96. The differences are best explained by rolling the greens. We rolled mostly on Fridays, Saturdays, and Sundays to gain some extra speed for the majority of Men's play. Surprisingly, we found that we didn't roll as much on Wednesdays, a situation that will be remedied this year. Looking at weekly averages for the time period, the graph clearly illustrates slower speeds after aerification, and faster speeds (not surprisingly) around the Canyon Classic and Boise Open Pro Am.

Other Comments:

Moving forward, Jon Atkins is basing his Master's Degree Project on the data we've collected since 2008, and of course this summer's as well. We continue to look for the factors behind green speed. At times last year we recognized a pattern of faster speeds after irrigation. This runs contrary to the popular belief in the industry that greens must be baked dry to be fast. We suppose that the extra moisture softens the surface enough that the roller creates a smoother surface than if the green was firmer and drier. We are comparing different cutting heights to see the effects (we think that this is perhaps the most important factor) and recording the volumetric moisture content on a daily basis to see if there is a correlation to speed. In fact, one area we stimp daily is right over one of our soil sensors. The soil sensor gives us the ability to compare soil temperature and speed as well. If you throw in other factors like fertility levels, topdressing, brushing, different mowers, Jon could probably do a doctoral thesis on factors that influence green speed the most.

Special thanks to Jon Atkins for the data compiling and analysis, and Jon, Randy Ernst and Dave Atkins, for being dedicated to collecting all the data points over the last year. If anyone would like the raw data, we can certainly provide it.

***Adam T. Bagwell**, CGCS, MPS*
www.adamtbagwell.com

Crane Creek Country Club

- *Research Goal*
  - To monitor and track quantitative green speed data and document its variation over the playing season with the intent of discovering what explanatory variables affect ball roll speeds on a day to day basis.

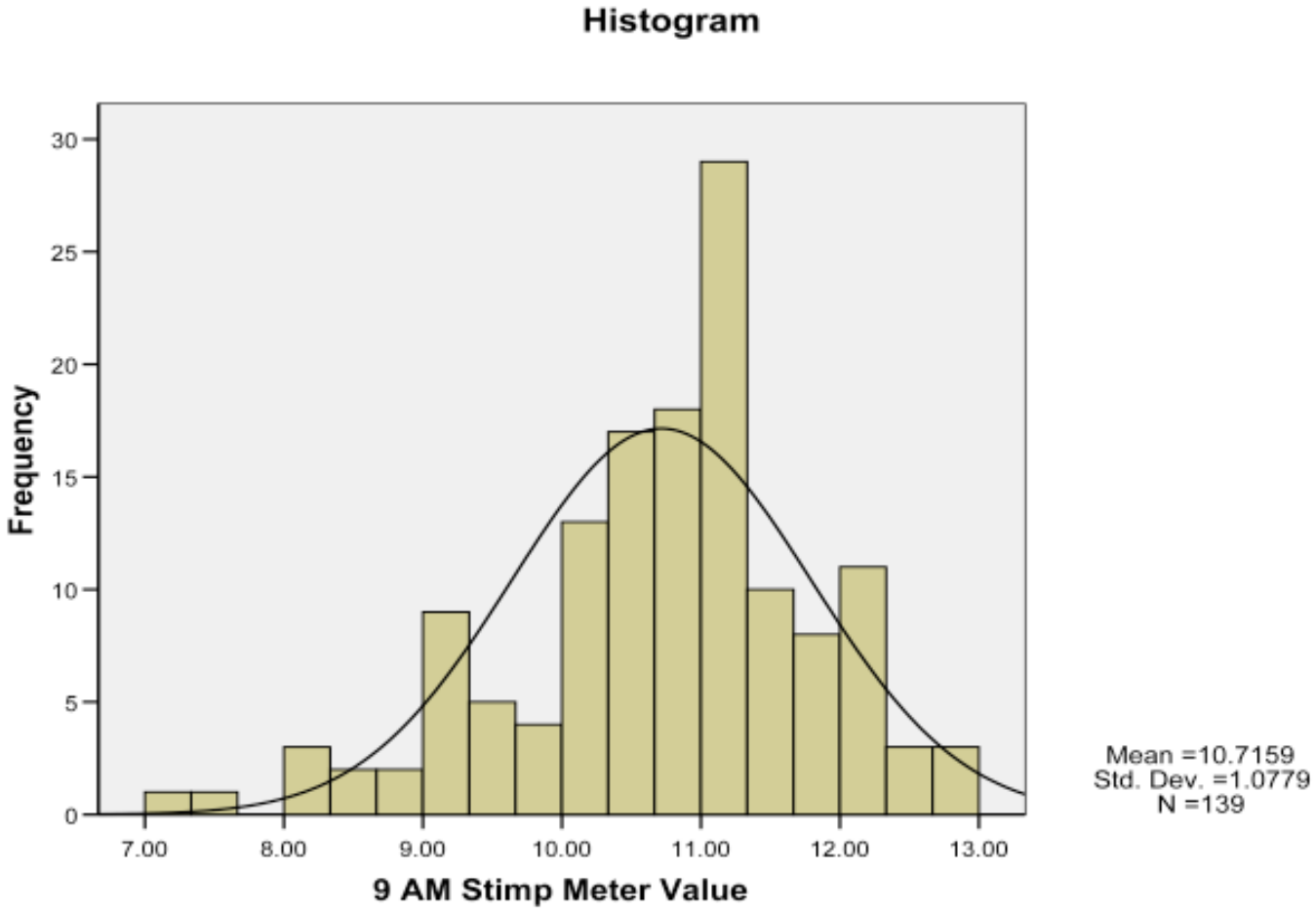
- *Research and Data Collection Methods*
  - Time Period
    - May 1 to October 1
  - Location
    - All green speeds were measured on #9 Green in the area directly above the TurfGuard Moisture Sensor on that green.
  - Means of Measurement
    - A standard Stimp Meter was used to quantify green speed.
  - Time of Measurement
    - The target time for measurement was 9:00 AM to ensure that all cultural practices were complete prior to stimping the green.
  - Documentation
    - Raw green speed data for each day was recorded on a hand-written chart designed for this purpose.
    - When time permitted, the data was entered into the database (Microsoft Excel).

- *Analysis*
  - SPSS (Statistical Package for the Social Sciences - ver. 16.0) was used to analyze the data exported from the Excel database.
  - The graphics listed below are all copied and pasted directly from the Output function in SPSS.

Green Speed Study 2011, Page 2 of 6

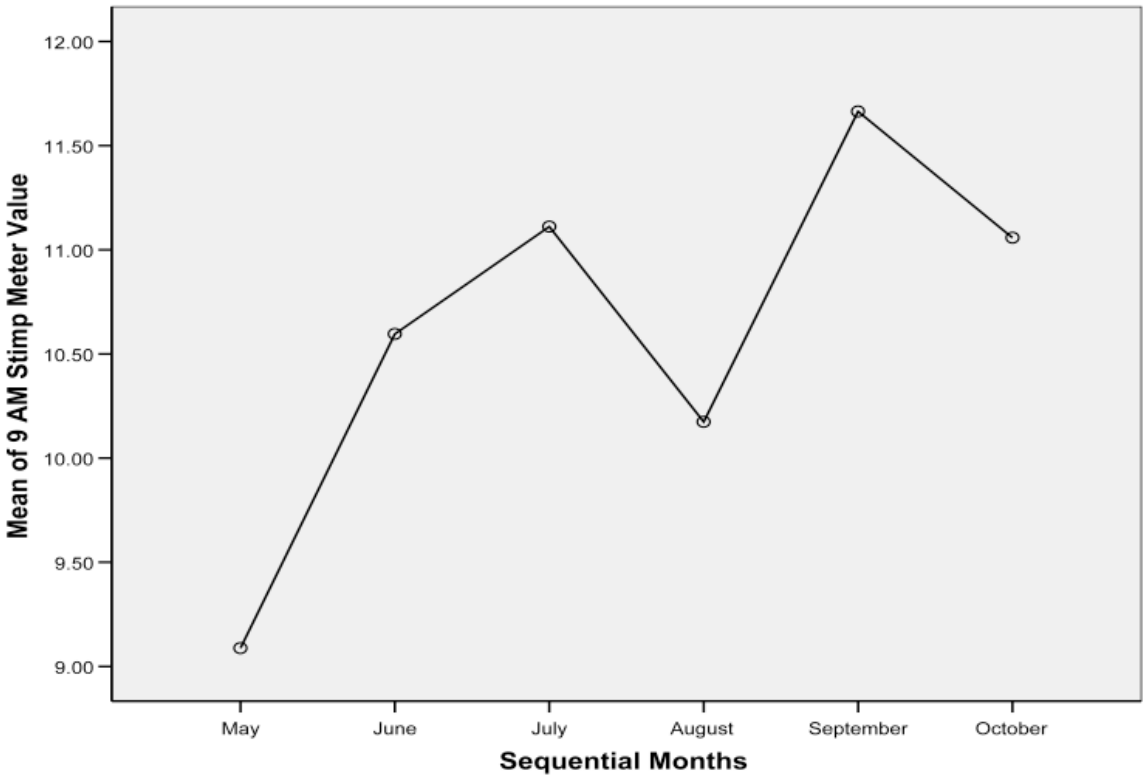
Measures of Central Tendency

The average green speed from May 1 to October 31, 2011, was 10.72 with a minimum green speed of 7.25 and a maximum green speed of 13.0. The median value was 10.83, which means that 50% of the green speeds measured were above this value and 50% were below this value. The mode, or most frequently occurring value, was 11.25. While this number does not tell us a whole lot at this level of measurement, it does explain why there is such a large bar above 11.0 on the histogram graph below. The standard deviation was 1.1 which means that on average the green speeds were quite consistent, only varying from the season average (10.72) by about a foot.



Green Speed Study 2011, Page 3 of 6

Green Speed Average by Month



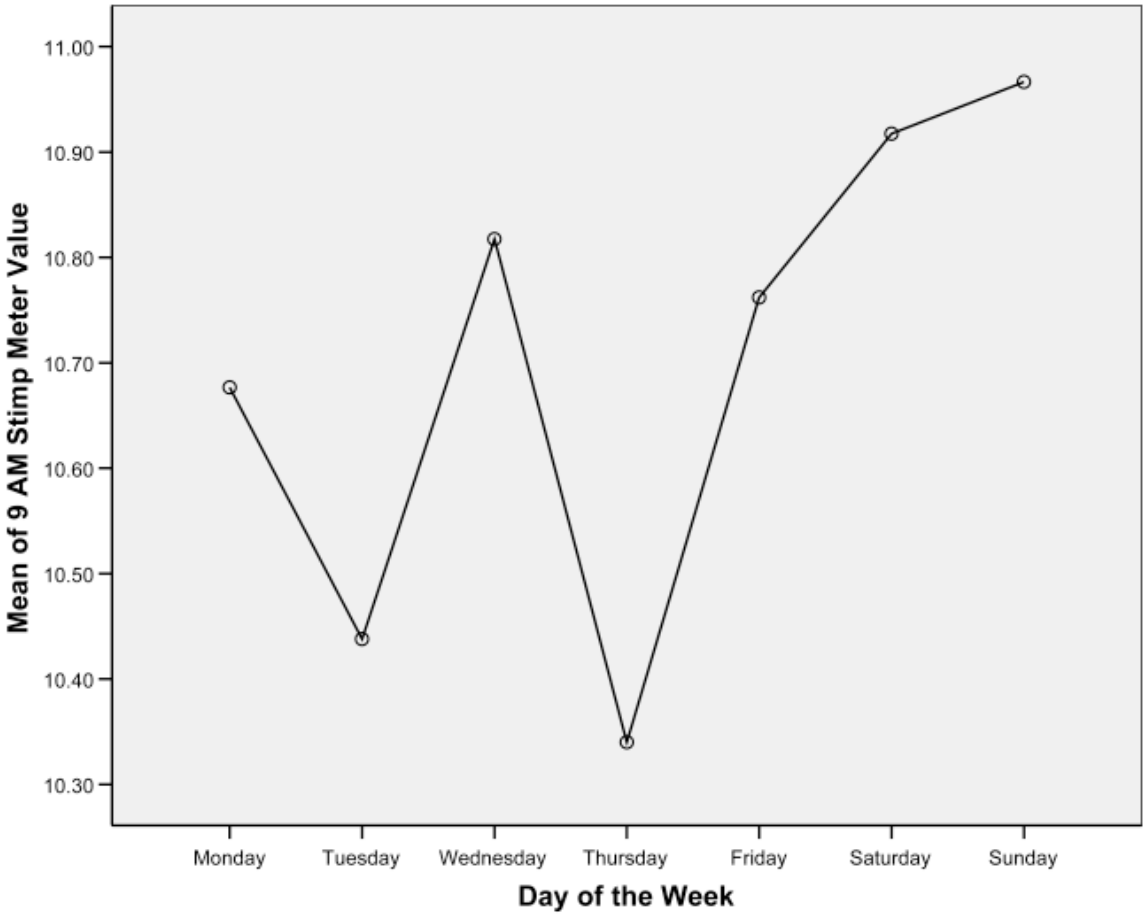
Descriptives

9 AM Stimp Meter Value

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
May	14	9.0879	.98230	.26253	8.5207	9.6550	7.25	10.60
June	29	10.5959	.59597	.11067	10.3692	10.8226	9.25	12.25
July	30	11.1113	.77224	.14099	10.8230	11.3997	8.75	12.50
August	25	10.1740	1.15240	.23048	9.6983	10.6497	8.00	12.00
September	23	11.6639	.76729	.15999	11.3321	11.9957	10.25	13.00
October	18	11.0578	.44709	.10538	10.8354	11.2801	10.50	12.00
Total	139	10.7159	1.07790	.09143	10.5351	10.8967	7.25	13.00

Green Speed Study 2011, Page 4 of 6

Green Speed Average by Day of the Week



Descriptives

9 AM Stimp Meter Value

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Monday	21	10.6767	1.18402	.25837	10.1377	11.2156	7.50	12.75
Tuesday	19	10.4379	1.35009	.30973	9.7872	11.0886	7.25	13.00
Wednesday	19	10.8174	.77729	.17832	10.4427	11.1920	9.25	12.00
Thursday	17	10.3400	.90108	.21854	9.8767	10.8033	8.63	12.00
Friday	20	10.7620	1.06740	.23868	10.2624	11.2616	8.75	12.50
Saturday	23	10.9174	1.03368	.21554	10.4704	11.3644	8.25	12.88
Sunday	20	10.9665	1.12716	.25204	10.4390	11.4940	8.20	12.50
Total	139	10.7159	1.07790	.09143	10.5351	10.8967	7.25	13.00

Green Speed Study 2011, Page 5 of 6

Green Speed Average by Sequential Weeks

This chart shows the average green speed for each week of the May 1 to October 31 period of time. Notice that the weeks in May and in August are lower on average than other weeks. This can be explained by aerification practices in May and August as well as heal time associated with each occasion. This identical trend can be inferred from the average green speed by month as green speed averages in both May and August were well below the average for the season. The line graph which represents this data is on the following page.

Descriptives

9 AM Stimp Meter Value

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
5/15 - 5/21	4	8.4375	.89849	.44925	7.0078	9.8672	7.25	9.25
5/22 - 5/28	7	8.8929	.69007	.26082	8.2547	9.5311	7.50	9.50
5/29 - 6/4	7	10.4986	.24856	.09395	10.2687	10.7284	10.25	10.88
6/5 - 6/11	6	10.3767	.48735	.19896	9.8652	10.8881	9.75	11.00
6/12 - 6/18	7	10.3043	.62766	.23723	9.7238	10.8848	9.25	10.75
6/19 - 6/25	7	11.1786	.65692	.24829	10.5710	11.7861	10.25	12.25
6/26 - 7/2	7	10.6014	.28615	.10815	10.3368	10.8661	10.25	11.00
7/3 - 7/9	7	10.2514	.85647	.32372	9.4593	11.0435	8.75	11.25
7/10 - 7/16	7	11.6000	.63180	.23880	11.0157	12.1843	10.75	12.50
7/17 - 7/23	7	11.4829	.38457	.14535	11.1272	11.8385	11.00	12.00
7/24 - 7/30	7	11.1671	.52971	.20021	10.6772	11.6570	10.50	12.00
7/31 - 8/6	3	11.1267	.12503	.07219	10.8161	11.4373	11.00	11.25
8/7 - 8/13	4	9.5950	1.04615	.52308	7.9303	11.2597	8.63	11.00
8/14 - 8/20	7	9.1371	.99851	.37740	8.2137	10.0606	8.00	11.00
8/21 - 8/27	7	10.5357	.83452	.31542	9.7639	11.3075	9.50	11.75
8/28 - 9/3	5	11.2020	.61690	.27589	10.4360	11.9680	10.50	12.00
9/4 - 9/10	5	10.8000	.59687	.26693	10.0589	11.5411	10.25	11.75
9/11 - 9/17	6	12.5217	.43683	.17833	12.0632	12.9801	12.00	13.00
9/18 - 9/24	5	11.9760	.39891	.17840	11.4807	12.4713	11.50	12.50
9/25 - 10/1	7	11.3400	.27544	.10411	11.0853	11.5947	10.88	11.75
10/2 - 10/8	4	10.5625	.12500	.06250	10.3636	10.7614	10.50	10.75
10/9 - 10/15	5	10.9520	.28604	.12792	10.5968	11.3072	10.63	11.25
10/16 - 10/22	5	11.2300	.38177	.17073	10.7560	11.7040	10.75	11.75
10/23 - 10/29	3	11.5433	.50560	.29191	10.2873	12.7993	11.00	12.00
Total	139	10.7159	1.07790	.09143	10.5351	10.8967	7.25	13.00

Green Speed Study 2011, Page 6 of 6

Green Speed Average by Sequential Weeks