Were the 1996–2000 Yankees the Best Baseball Team Ever?*

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Introduction

In the aftermath of the New York Yankees' 2000 World Series victory over the New York Mets, 4 games to 1, many fans, sportswriters, and baseball insiders focused attention on whether the Yankees' achievement of four World Series championships in five years was the most impressive team accomplishment in the history of the sport. In particular, how did it compare to the five championships in six years (including four consecutive championships) of the 1936–1941 Yankees, or the six championships in seven years (including five consecutive championships) of the 1947–1953 Yankees?

A commonly expressed opinion was that of MSNBC sports columnist Bob Herzog, who wrote "The greatest team in Yankees history is playing right now." The reason commonly given for this opinion is that with two postseason playoff rounds before the World Series, there is the added difficulty of just getting to the World Series (let alone, and then winning it). "The simple act of repeating is more difficult than ever" opined Fox Sports commentator Keith Olbermann, and Atlanta Braves manager Bobby Cox agreed, saying "It's so hard to go all the way every year now. It's amazing to me what the Yankees have done."

While it is certainly true that it is harder to win three series (one best 3 out of 5 games, two best 4 out of 7 games) than to win one (best 4 out of 7 games), that is only half the story. What Herzog, Olbermann, and Cox are ignoring is that it is apparently easier now to get into the postseason, when eight teams are eligible, than it was 50 years ago, when only two teams

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were eligible. In this paper we examine both sides of the question, and try to establish whether it really is harder to win the World Series now.

The first step is to acknowledge that we are not going to actually answer the question posed in the title. While it might be a more impressive achievement to win three series, rather than one, in order to win a championship, that hardly implies that a team that only had to win one series is less good. After all, it isn't the fault of the 1927 Yankee team, which won more than 71% of its regular season games and then swept the World Series from the Pittsburgh Pirates, that it only had to win four postseason games to win it all! Rather, we will attempt to quantify the "impressiveness" of a given team's achievement, as the answer to the question "How surprising would it be for a team to achieve that level of regular season and postseason success?"

Measuring impressiveness

Answering the question that closed the previous section involves several steps. First, we must define what we mean by "that level of regular season and postseason success." Since the number of games played in a season has varied over time, regular season success should be assessed using winning percentage, rather than number of wins. If a team wins 100 out of 162 games, for example, that corresponds to a winning percentage of .617, and we will treat that event as having a winning percentage of at least .617. The intuition behind this is that when a baseball fan refers to a team "winning 100 games," they actually mean *at least* 100 games (that is, a team that wins 102 games also "won 100 games").

Postseason success corresponds to a two–part process. First, a team must earn a position in postseason play. Before 1969, only one team from each league (American and National) earned a spot in the World Series, the only postseason competition. From 1969 through 1993, each league was divided into two divisions, with the division winners in each league first playing each other in a League Championship Series, and the league champions then meeting in the World Series. Since 1995 each league has been split into three divisions, and the three division winners, plus the team with the next best record (the wild card team), play in the Division Series, with the winners playing in the League Championship Series for the right to play in the World Series. There was no postseason play in 1994 because of a players' strike. These different systems mean that the impressiveness of a team's achievement

in making the postseason was very different in 2000 than it was in 1950, with four times as many slots available.

The second part of postseason success is simply how many series a team won. While it could be argued that a 4–games–to–0 World Series triumph is more impressive than 4–games–to–3, ultimately all that is remembered is which team won.

Putting these three steps together gives our impressiveness measure. Say a team has winning percentage x ($0 \leq x \leq 1$), and ultimately wins the World Series. The impressiveness of that feat is

$$P(\text{Team having winning percentage} \geq x \textit{ and } \text{Team making the postseason} \textit{ and } \text{Team winning the World Series}). \quad (1)$$

Let X be the random variable corresponding to the winning percentage for a randomly chosen team, with underlying density function $f(\cdot)$. Let S represent the event of making postseason play, and let W represent the event winning the World Series. By the definition of conditional probability, the impressiveness measure equals

$$\begin{aligned} & P(X \geq x \textit{ and } S \textit{ and } W) \\ & \quad = P(X \geq x \textit{ and } S) P(W|S, X \geq x) \\ & \quad = \left[\int_x^1 P(S|X = w) f(w) dw \right] P(W|S, X \geq x). \end{aligned}$$

Each of the terms in this formula can be estimated from the data. The density $f(\cdot)$ can be estimated using any density estimate; since we are particularly interested in density estimates in the tails, we will use a local quadratic likelihood density estimate, which is known to have favorable tail behavior (see Hjort and Jones, 1996, and Loader, 1996). The estimate $\hat{f}(x)$ is defined as the maximizer of

$$\sum_{i=1}^{n} K\left(\frac{x - x_i}{h}\right) \log[f(x_i)] - n \int K\left(\frac{x - u}{h}\right) f(u) du,$$

where K is the kernel weight function, h is a smoothing parameter that controls the smoothness of the estimate, and $\log f(\cdot)$ is modeled to be locally quadratic in x. We use the corrected AIC criterion to choose the smoothing parameter (Simonoff, 1998), although the estimates turn out to be relatively insensitive to smoothing parameter choice for these data. In order to reflect

the changing pattern of winning percentages over time, separate density estimates are constructed for the three eras of the so–called "modern age" of baseball (1920–1968, 1969–1993, and 1995–2000). We could consider using the empirical cumulative distribution function to estimate $P(X \geq x \; and \; S)$, thereby avoiding smoothing. Since our primary interest is in teams that did well during the regular season, however, there is not enough data in this upper tail for effective estimation.

The conditional probability $P(S|X)$ is estimated from the data based on a logistic regression model,

$$\log \frac{P(S)}{1 - P(S)} = \beta_0 + \beta_1 X.$$

Clearly the coefficients of this model will be different for the different eras examined, and the models will be fit separately.

The final probability, $P(W|S, X \geq x)$ potentially allows for great simplification. If the two teams in any postseason series are evenly matched, the probability of winning a series is simply .5; assuming independence of the postseason series (a coin–tossing model), the probability of winning the World Series once the team has qualified for the postseason is .5 (pre–1969), .25 (1969–1993), and .125 (1995–2000), respectively. It is possible to refine these figures by allowing the probability of winning a series to be a function of the quality of the two teams playing in the series; we will examine this possibility later.

Empirical results

The analyses presented here are based on data for all teams for the major league seasons 1920 through 2000, excepting 1981 and 1994. We begin with 1920 since that is generally considered as the beginning of the modern era of baseball (succeeding the "dead ball" era). Both 1981 and 1994 were disrupted by player strikes that affected the postseason (1981 was played as a split season, with first–half champions playing against second–half champions in the postseason, a one–of–a–kind arrangement and thus not suited for inclusion in our analysis, while the 1994 postseason was canceled). This time period is split into three eras: Era 1, 1920 through 1968 (when one team per league played in one postseason playoff series, the World Series), Era 2, 1969 through 1993 (when two teams per league played in two postseason playoff

series, the League Championship Series, and the World Series), and Era 3, 1995 through 2000 (when four teams per league have played in three playoff series, the Division Series, League Championship Series, and World Series).

Figure 1 gives density estimates for the winning percentages for all teams for the three eras (era 1, solid line, era 2, dotted line, and era 3, dashed line). The average winning percentage in any year is of course .500, but it is noticeable that in the earliest era the distribution of winning percentages is decidedly asymmetric (with mode at .520 and a long left tail), and exhibits higher variability (the standard deviation of winning percentages for this era is .09). The winning percentage distributions for the latter two eras are very similar, both being reasonably symmetric, peaking at .500, with less variability than for era 1 (standard deviation of winning percentages .069 for both). These densities imply that competitive balance has been much greater in the last 30 years than in the previous 50 years. While almost 15% of all major league baseball teams won at least 60% of their games during era 1, only about 7% did in eras 2 and 3; the percentages winning at least two–thirds of their games are 2.0%, 0.7%, and 1.1%, respectively. Unfortunately, this surfeit of apparent excellence in the earlier part of the century is balanced by excess incompetence, with 14.5% of major league teams in era 1 winning fewer than 40% of their games (compared with 8.5% and 4.6% in eras 2 and 3, respectively), and 3.9% winning no more than one–third of their games (compared with 0.7% and 1.1% for eras 2 and 3, respectively). This means that a winning percentage of .614 in era 1 (the best 10% of performances) is equivalent to a winning percentage of .591 in the latter eras, which corresponds to almost four fewer wins in a 162–game schedule.

The paleontologist Stephen Jay Gould noted this same pattern of narrowing distributions (and hence fewer batters with extraordinarily high averages) over the years when examining batting averages (Gould, 1986). Rather than point to this as evidence of a decline of hitting ability, he attributed the pattern to an overall increase in quality of both pitchers and hitters. The same argument holds here: with fewer profoundly poor teams in baseball (such as the Philadelphia Phillies, which lost more than 65% of their games 11 times between 1921 and 1945, or the Boston Red Sox, which did so 9 out of 14 years from 1922 to 1935), it is now much more difficult for even truly excellent teams to have dominant seasons. Chatterjee and Yilmaz (1991) noted declining variability in team winning percentages over time. Berry (2001), in a study of team abilities during the most recent regular seasons

of the four major North American sports (baseball, basketball, football, and hockey), found considerably less variability in team ability (that is, greater competitive balance) in baseball than in the other three sports.

Figure 2 gives the three separate fitted logistic regressions used to model the relationship between the probability of getting into postseason play and winning percentage, for the three eras. Each team's response (make playoffs or don't make playoffs) is modeled as independently Bernoulli distributed, ignoring the slight dependence that comes from the fixed number of postseason spots in a given year. As would be expected, the curves are shifted to the left in each successive era, corresponding to a higher probability of appearing in the postseason for any given winning percentage (since a higher percentage of teams make the playoffs). The winning percentages corresponding to a 50% chance of making the playoffs (called the ED50 in the biostatistical literature) are .611, .577, and .543, respectively. As would be expected, this also translates into the potential for World Series winners with lower winning percentages than before, such as the 1987 Minnesota Twins (with a winning percentage of .525) and 2000 New York Yankees (with a winning percentage of .540).

The two factors of a narrowing distribution (Figure 1) and increased probability of making the postseason (Figure 2) combine to give Figure 3. This figure gives the probabilities of a team having at least a given winning percentage and making the postseason. The figure shows that the increased number of playoff spots recently is not the only story in evaluating the ease of making the postseason. For winning percentages up to 55–60%, it was indeed more difficult in era 1 to achieve at least that level of regular season success and make the postseason (which, in that era, meant winning the league championship), because of the limited number of postseason spots (2 for 16 teams). However, the much higher probability of achieving a winning percentage higher than 60% in the earliest era means that it was, in fact, *easier* to have a winning percentage over 60% (or any value higher than that) and reach the postseason before 1969 than it has been since then.

The final calculation needed is that of winning the World Series, given a team makes it to the postseason. We first consider the simple coin–tossing model (we will discuss a more complex model in the next section). The values .5, .25, and .125, respectively, are multiplied by the values in Figure 2 to give the impressiveness measures in equation (1), presented in Figure 4. The picture here is very clear. For any given winning percentage, it was a more impressive feat to achieve that level of success and then win the World Series

in era 2 than it was in era 1, and it is more impressive now than it was in era 2. When combined with the implication of increased overall quality from Figure 1, the ability to win championships with any consistency nowadays is quite remarkable.

What were the most impressive teams ever?

There are (at least) two ways that we could use these results to assess the most impressive teams ever (or, at least, since 1920). Table 1 lists the ten most impressive championship performances since 1920. The entries under I_1 refer to the impressiveness measure defined in the previous section (I_2 will be described below). Note that by requiring a championship performance, several teams with very impressive regular season performances (that might have appeared in the table), such as the 1931 Philadelphia Athletics, 1954 Cleveland Indians, 1969 Baltimore Orioles, and 1995 Cleveland Indians, are excluded; when considering one–year performance, this seems reasonable, since presumably none of the members of those teams would have considered the year as completely successful.

The most obvious message in Table 1 is that the performance of the 1998 New York Yankees was by far the most impressive performance of the last 80 years. Winning more than 70% of their regular season games in the current era is remarkable in itself, and to then add to that victory in three playoff series (with a record of 11–2) puts their impressiveness rating less than one–tenth the next best value. The next best performance is shared by three teams from era 2 (1970 Baltimore Orioles, 1975 Cincinnati Reds, and 1986 New York Mets) that won two–thirds of their games and then a League Championship Series and World Series. The famous "Murderer's Row" 1927 New York Yankees of Babe Ruth and Lou Gehrig round out the top five, based on the second–best regular season percentage of the last 80 years (the 1954 Indians had the best regular season percentage). As was noted earlier, this team reinforces the distinction between most impressive team and best team, since the 1927 Yankees did everything they were asked, and would probably have beaten any other playoff opponent put in front of them. Still, Table 1 is comforting, since it includes many teams that are commonly considered among the best of all time. For example, Rob Neyer and Eddie Epstein, in their book *Baseball Dynasties* (Neyer and Epstein, 2000), rate five of the top six teams in Table 1 as being the five best teams

since 1910, the only exception being the 1986 Mets (which they put in the top ten all–time).

As we noted earlier, a simple coin–tossing (equiprobable) model is used in I_1 to determine the probability of any team winning a postseason series. We could imagine that better estimates of winning a series could be derived based on the available data, such as the difference between the winning percentages of the two teams in the series. Let p be the probability that the better team wins a series. We estimate p as a function of the difference between winning percentages of the two teams X through a logistic regression with zero intercept,

$$\log \frac{p}{1-p} = \beta_1 X.$$

This model, with the intercept constrained to be zero, forces the estimated probability of each team winning to be .5 when the teams have the same record.

Table 2 summarizes the results of such model fitting. For each type of series in each era, the cumulative won–loss record of series of the better team is given (so, for example, in World Series during era 1, the team with the better record won 25 of 47 series). Four series were omitted from the table because the two teams had identical regular season records (the 1949 and 1958 World Series, 1992 American League Championship Series, and one 2000 National League Division Series). The odds–ratios (OR) given in the table correspond to the multiplicative factor on the odds of the better team winning if it won one more game than its opponent (based on a 154–game season in era 1, and a 162–game season in eras 2 and 3). So, for example, in era 1 the better team had an estimated 6% higher odds of winning the World Series for each additional victory it had over its opponent. The p–values given refer to the likelihood–ratio test of the significance of difference in winning percentage as a predictor.

A very interesting pattern emerges in Table 2. The only regressions that are at all close to statistical significance are the first series in each era: the World Series in era 1 ($p = .16$), the League Championship Series in era 2 ($p = .01$), and the Division Series in era 3 ($p = .10$). After the first series, there is no evidence that regular season superiority has any relationship to winning a series (for example, in the last 30 World Series, the team with the better regular season record *lost* 17 times). It is easy to imagine a psychological explanation for this: while teams with lesser regular season records might not be very confident going into their first series against a

good team, if they win it, they feel that they have proved that they can compete, and are much more self–assured (and therefore more successful) in later series. In each of the first series, each additional regular season win increases the odds of winning 6–10%. The entries in Table 1 under I_2 refer to impressiveness measures where the probability of winning the first series for that team is based on logistic regression (the probability of winning any other series is taken to be .5). It is apparent that while there are slight changes in the relative positions of the teams (with the 1929 Philadelphia Athletics moving up, because of their defeat in the World Series of a Chicago Cubs team with a .645 winning percentage, and the 1984 Detroit Tigers moving down, on account of the .519 winning percentage of the Kansas City Royals, their American League Championship Series opponent), the basic themes remain the same. Berry (2001) used his regular season ability measure to estimate the chances of each 2000 postseason qualifier winning the World Series (given they have qualified), and also found that it did not vary greatly from the .125 value of the coin–tossing model.

As noted in the introduction, however, it is not one–year performance that has led to the Yankee teams of the '30s, '50s, and '90s to be considered the best ever, but rather sustained brilliance. Table 3 addresses this question. The four teams we consider include three versions of the New York Yankees: the 1936–1941 team, which won 5 titles in 6 years (including 4 in a row), the 1947–1953 team, which won 6 titles in 7 years (including 5 in a row), and the 1996–2000 team, which won 4 titles in 5 years (including 3 in a row). Each of these teams includes a year where the Yankees did not win the World Series, which must be addressed. The 1940 Yankees finished third in the American League with a record of 88–66, so its impressiveness measure only includes the probability of having a winning percentage of at least .571. Similarly, the 1948 Yankees had a record of 94–60, but finished third in the standings. The 1997 Yankees qualified for the postseason as a wild card with a record of 96–66, but lost in the division series to Cleveland, so their impressiveness does not include any postseason series victory effect. The impressiveness for any string of years is defined as the product of individual year's impressiveness. This is based on an independence assumption that is undoubtedly violated, but it is not apparent how to correct for this. In order to account for the years that did not end in World Series championships, the product obtained is then multiplied by the number of ways that a team could win 5 titles in 6 years ($\binom{6}{5}$, or 6), 6 titles in 7 years (7), or 4 titles in 5 years (5), respectively. The fourth team is the 1971–1975 Oakland A's. This is the only other team to

win three consecutive World Series (1972–1974), and they also finished first in their division in 1971 and 1975 (Neyer and Epstein include this team as one of the top ten major league teams since 1920). Note that their impressiveness for 1971–1975 is multiplied by $\binom{5}{3} = 10$, the number of ways to win three titles in five years.

We must be clear that we are ignoring the fact that these particular years were chosen *after* seeing their exceptional nature, and thus the final impressiveness measures cannot be viewed as prospective probabilities. There is also a difficulty in comparing strings of years of different lengths, since each additional year multiplies the impressiveness by a number less than one, reducing it. We correct for this as follows: if the original measure is based on k years, the final measure reported is its kth root. If all of the years were championship years, this would correspond to the geometric mean of the annual impressiveness measures.

The verdict is very clear: the success of the 1996–2000 Yankees is the most impressive run of any team in the past 80 years, and this team has earned the right to be considered the best Yankee team ever. The 1949–1953 Yankees, which won five straight championships, suffer in comparison to the team of 1936–1941, since the earlier team won more than 100 games four times, while the later team never won more than 99. It might be surprising that the 1971–1975 A's performance is apparently comparable to the 1947–1953 Yankees, a team that won five straight championships. The A's are probably overlooked as a great team for several reasons. Their best regular season performances came in 1971 and 1975, when they lost in the American League Championship Series and didn't even appear in the World Series. They also suffered from the lack of recognition of the pattern in Figure 1, that a .600 winning percentage in 1972 was considerably more impressive than it would have been 20 or 30 years earlier (being so early in era 2 would reinforce that problem). Finally, the additional playoff round made it more difficult to win the World Series (as they learned in 1971 and 1975!).

Having said that, the comparison in Table 3 is a bit unfair. It is reasonable to just look at the 1949–1953 Yankees when comparing to the 1971–1975 A's and 1996–2000 Yankees, since then all three comparisons are based on five consecutive years. The overall impressiveness I_1 of the 1949–1953 Yankees is 0.028318, much closer to that of the earlier Yankee team, and considerably better than that of the A's.

Conclusion

In this paper we have proposed a measure of how impressive a team's performance is, taking into account the competitive balance in the league and the playoff structure. While this is not the same as measuring which team is best, it does provide one way of comparing teams from different eras, and impressiveness seems to correlate well with acknowledged "greatness" of a team. The performance of the 1996–2000 New York Yankees, and in particular the 1998 Yankees, stands out as being the most impressive of the past 80 years of major league baseball.

Postscript

This paper was completed before the end of the 2001 baseball season, and is based on data through the 2000 season. The New York Yankees finished the 2001 regular season with a .594 winning percentage, and went on to defeat the Oakland A's (with winning percentage .630) and Seattle Mariners (with winning percentage .716) to win the American League championship, before falling to the Arizona Diamondbacks (with winning percentage .568) in seven games in the World Series. Including this year in a 1996–2001 treatment of the Yankees would change the impressiveness measures to $I_1 = 0.016991$ and $I_2 = 0.014143$, and we have chosen to focus on the 1996–2000 version of the team here.

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Table 1: Most impressive championship teams since 1920. The I_1 measure is based on assuming equiprobable winners in postseason series, while I_2 uses regular season record to estimate probability of winning first postseason series.

Rank	*Team*	*Record*	*Winning pct.*	*Series won*	I_1	I_2
1	1998 New York Yankees	114–48	.704	3	0.000173	0.000306
2	1975 Cincinnati Reds	108–54	.667	2	0.001919	0.002500
	1970 Baltimore Orioles					0.002790
	1986 New York Mets					0.002933
5	1927 New York Yankees	110–44	.714	1	0.002229	0.003170
6	1939 New York Yankees	106–45	.702	1	0.003777	0.004921
7	1995 Atlanta Braves	90–54	.625	3	0.004340	0.006574
8	1984 Detroit Tigers	104–58	.642	2	0.004955	0.008686
9	1932 New York Yankees	107–47	.695	1	0.004975	0.007189
10	1929 Philadelphia Athletics	104–46	.693	1	0.005363	0.006476

Table 2: Performance of better team in different series in different eras. "W–L" is the won–loss record of the better team in the series, "OR" is the odds ratio for one additional victory for the better team, and p is the p–value for the significance of the difference in winning percentage in a logistic regression of series victory on difference in winning percentage.

	Division Series	*League Championship Series*	*World Series*
Era 1			W–L: 25–22 OR: 1.06 $p = .16$
Era 2		W–L: 28–19 OR: 1.10 $p = .01$	W–L: 11–13 OR: 0.99 $p = .77$
Era 3	W–L: 12–11 OR: 1.08 $p = .10$	W–L: 7–5 OR: 1.06 $p = .26$	W–L: 2–4 OR: 0.98 $p = .81$

Table 3: Impressiveness measures for the teams that won at least three consecutive titles.

Year	*Status*	*Winning pct.*	I_1	I_2
1936 Yankees	Champion	.667	0.012731	0.016443
1937	Champion	.662	0.014729	0.017092
1938	Champion	.651	0.019866	0.025383
1939	Champion	.702	0.003777	0.004921
1940	Third place	.571	0.219362	0.219362
1941	Champion	.656	0.017402	0.017892
			0.026184	0.030635
1947 Yankees	Champion	.630	0.032162	0.034871
1948	Third place	.610	0.107670	0.107670
1949	Champion	.630	0.032162	0.032162
1950	Champion	.636	0.028402	0.033927
1951	Champion	.636	0.028402	0.029898
1952	Champion	.617	0.040330	0.038484
1953	Champion	.656	0.017402	0.015435
			0.046083	0.047035
1971 A's	Won division	.627	0.032701	0.032701
1972	Champion	.600	0.017327	0.023711
1973	Champion	.580	0.025735	0.021980
1974	Champion	.556	0.033606	0.031961
1975	Won division	.605	0.061332	0.061332
			0.049612	0.051125
1996 Yankees	Champion	.568	0.019986	0.021538
1997	Wild card	.593	0.088588	0.088588
1998	Champion	.704	0.000173	0.000306
1999	Champion	.605	0.007971	0.008897
2000	Champion	.540	0.030457	0.025126
			0.013008	0.014552

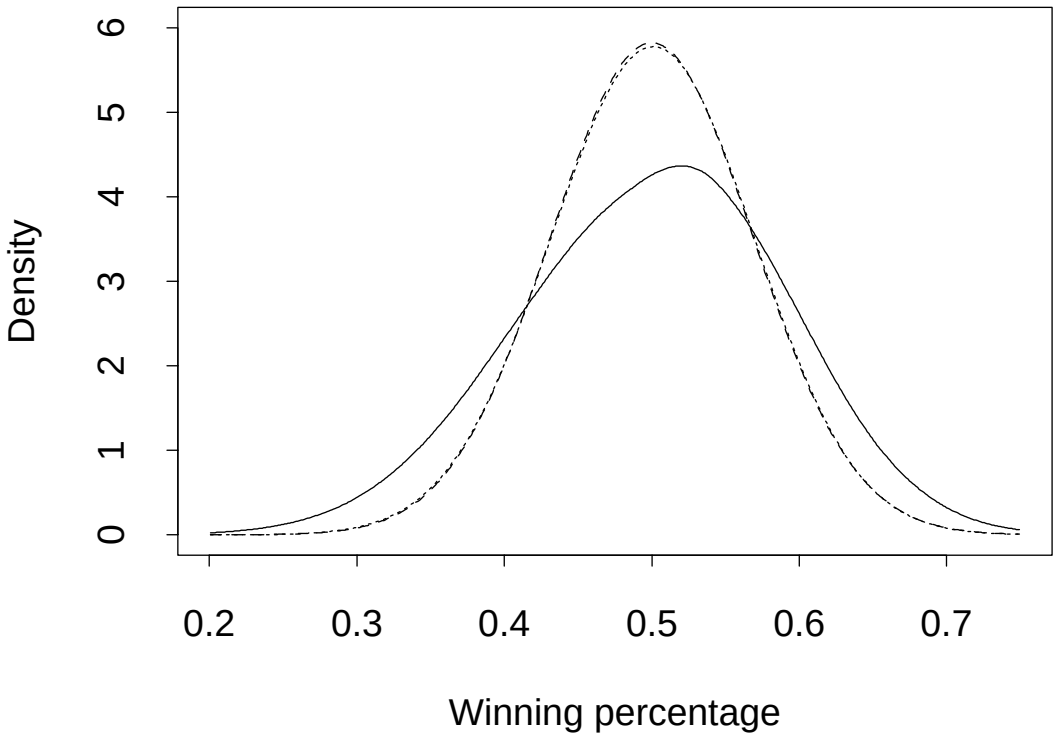

Figure 1: Density estimates of winning percentage by era. Solid line: era 1 (1920–1968); Dotted line: era 2 (1969–1993); Dashed line: era 3 (1995–2000).

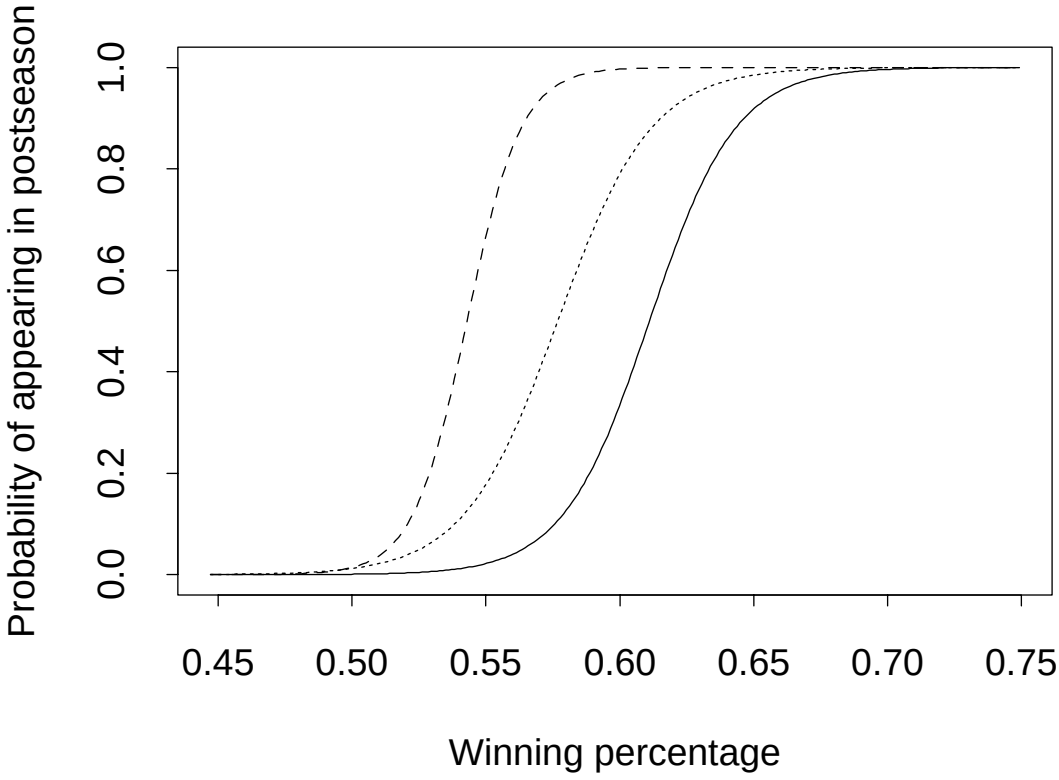

Figure 2: Estimates of the probability of qualifying for postseason play as a function of winning percentage by era. Solid line: era 1 (1920–1968); Dotted line: era 2 (1969–1993); Dashed line: era 3 (1995–2000).

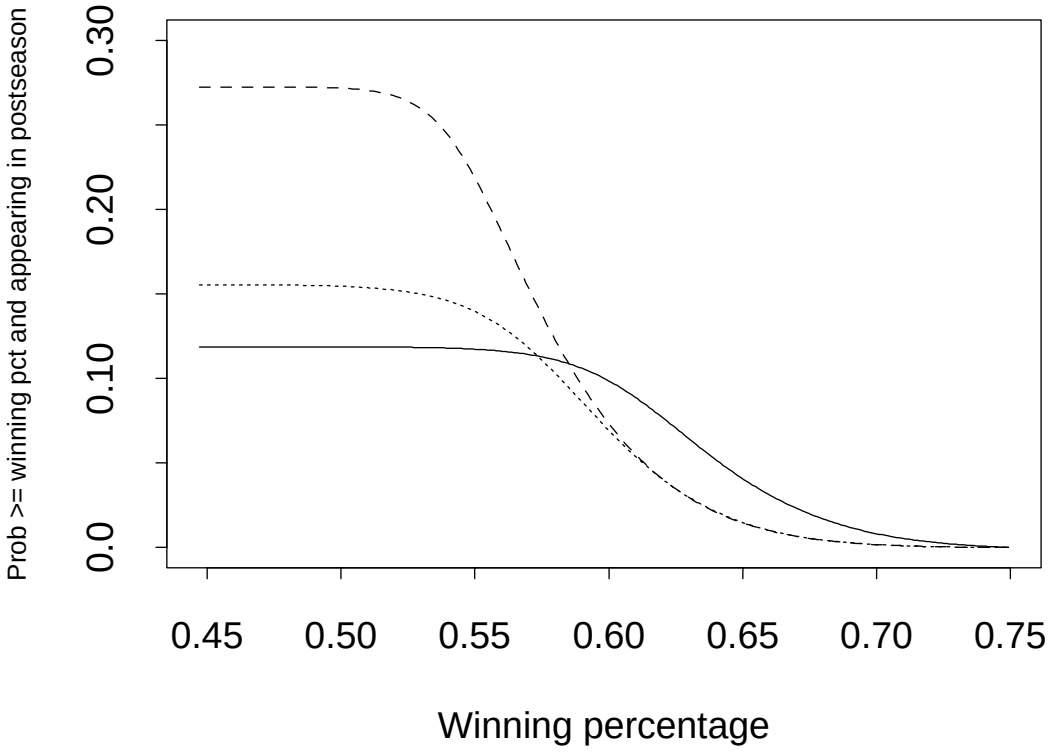

Figure 3: Estimates of the probability of achieving at least a given level of regular season success and qualifying for the postseason, by era. Solid line: era 1 (1920–1968); Dotted line: era 2 (1969–1993); Dashed line: era 3 (1995–2000).

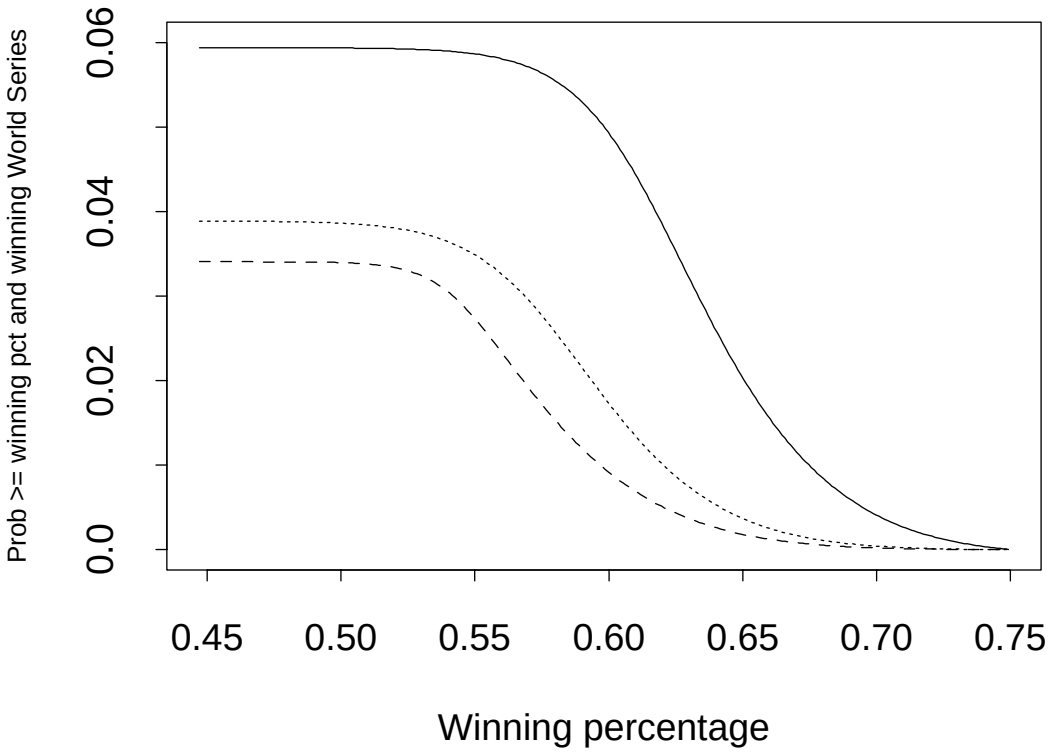

Figure 4: Estimates of the probability of achieving at least a given level of regular season success and winning the World Series, by era. Solid line: era 1 (1920–1968); Dotted line: era 2 (1969–1993); Dashed line: era 3 (1995–2000).