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In the Matter of	)	
DETERMINATION OF RATES AND TERMS FOR DIGITAL PERFORMANCE IN SOUND RECORDINGS AND EPHEMERAL RECORDINGS (WEB IV)	)	Docket No. 14-CRB-0001-WR

TESTIMONY OF

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I. INTRODUCTION

1. My name is Daniel L. McFadden. I am the E. Morris Cox Professor Emeritus of Economics at the University of California, Berkeley, and the Presidential Professor of Health Economics at the University of Southern California. I am also a principal at The Brattle Group. I received a Bachelor of Science degree in physics, with high distinction, in 1957, and a Ph.D. degree in behavioral science, with specialization in economics, in 1962. Both degrees are from the University of Minnesota.

2. I received the 2000 Nobel Memorial Prize in the Economic Sciences for developing methods and theory used in analyzing how consumers and households make choices from sets of discrete alternatives. My work is now a standard tool in analyzing consumer behavior in a wide variety of markets. It is used to determine how people choose one brand of product over others and how they decide to purchase one type of product over another. Discrete choice modeling is used to understand what features consumers value and how they respond to price changes and to product information. My work also is used commonly in making public policy and regulatory decisions.

3. I received the 2000 Nemmers Prize in Economics, awarded by Northwestern University to recognize "work of lasting significance." In 1975, I received the John Bates Clark medal, awarded biennially to the economist under 40 judged to have made the greatest contribution to the profession. I also have received the Frisch medal (1986), awarded biennially for the best empirical paper in Econometrica; the Outstanding Paper Award of the American Association of Agricultural Economics (1995), the Richard Stone Prize for the best paper in the Journal of Applied Econometrics (2002), and the Jean-Jacques Laffont Prize (2006) for lifetime achievement.

4. I have served as the E. Morris Cox Professor of Economics at the University of California, Berkeley, the James Killian Professor of Economics at the Massachusetts Institute of Technology, the Irving Fisher Research Professor at Yale University, and as a Fairchild Distinguished Scholar at the California Institute of Technology. I have been elected a Fellow of the American Academy of Arts and Sciences, of the National Academy of Science, and of the American Philosophical Society, and have received an honorary LL.D. degree from the University of Chicago, and honorary doctoral degrees from

Huazhong University of Science and Technology, the University of London, the University of Montreal, the University of Buenos Aires, and North Carolina State University. I have served as President of the Econometric Society and as Chairman of the Berkeley Department of Economics. I served as President of the American Economics Association in 2005. I served as a technical advisor to the Antitrust Division of the U.S. Department of Justice on the analysis of anticompetitive impacts of several proposed mergers beginning (1995-1996).

5. My teaching areas include economic theory, econometrics, and statistics at the graduate level. I have published seven books and more than 100 professional papers. My curriculum vitae is appended to this report as Appendix A.

II. ASSIGNMENT

6. I have been asked by counsel for SoundExchange, Inc. to perform an analysis of consumer demand for internet music streaming services. Specifically, I was asked to estimate the relative value that consumers place on certain attributes commonly offered by music streaming services. For example, I was asked to determine the relative value that consumers place on being able to listen to music without advertising interruptions or to be able to listen to a song "on demand." To do so, I have conducted a survey of current and potential users of internet music streaming services. I understand that the results of my conjoint survey may be relied upon by Dr. Daniel L. Rubinfeld.

III. SUMMARY OF FINDINGS

7. My survey design and model follow established scientific practice. After careful review of the results of the survey, including sensitivity analysis and robustness checks described below, it is my opinion that the model of consumer behavior I use provides reliable and substantial information explaining consumers' valuation of the features tested for music streaming services. An important feature of the survey design is that respondents were encouraged to try the Pandora® and Spotify® branded music streaming services. This ensured that most respondents had some familiarity with the typical attributes offered by music streaming services, including the attributes that they were asked to evaluate in my study.

8. My survey results show the values that current and potential consumers of music streaming services place on the various features. Specifically, I have calculated these values for a weighted sample of potential future users of music streaming services. This group best represents those individuals who constitute the market for music streaming services.

9. I have focused my results on the values for those features that I understand are not available under the statutory license. On average, the potential future users have a value of $1.30 per month for the functionality of "on demand" access to music (for both computer and mobile devices). The average value these potential future users place on the ability to listen to music offline is $1.18 per month and the average value of having unlimited skips is $1.41 per month. Other features of value for potential future users include the ability to forgo advertisements ($1.33 per month) and an increase in the size of the music catalogue to 20 million tracks ($1.60 per month).

10. I find that consumers of streaming services divide between those who are willing to pay for these services and the extra features they offer and those who are averse to paying for music streaming services and place relatively low values on these extra features. In particular, I find that willingness to pay for those features not available under the statutory license is much higher among those willing to pay for a streaming music service than among those who are interested in only a free streaming music service. Ultimately, the average values that I present for these features account for both groups of users because both on demand and webcasting services derive revenues from paid subscriptions as well as advertising-supported subscriptions.

11. The remainder of this report summarizes the design of the survey and describes the results. Section IV provides a general overview of the methodology that I used. Section V explains how I designed and administered the survey to measure values for various music streaming service attributes. Section VII explains how I estimated consumers' valuations for the various attributes of music streaming services, focusing on their valuations of those features not available under the statutory license. Section VIII concludes.

IV. OVERVIEW OF CONJOINT METHODOLOGY

12. The basic survey methodology that I use is known as conjoint analysis. Conjoint analysis was introduced to the field of marketing research in 1971 and is generally recognized by academics and practitioners to be the most widely studied and applied form of quantitative consumer preference measurement. Under suitable conditions, a carefully designed conjoint analysis can provide reliable measures of consumer preferences and predictions of consumer behavior. The conditions under which conjoint analysis surveys have proven most consistently reliable are when product features and levels considered in the elicitations are complete, clear, and realistic, when consumers are either familiar with the products or have an opportunity to test out and learn about their features, and when the subject has a positive incentive to be careful and truthful in responding.[1]

13. Researchers use conjoint surveys to estimate the value that consumers place on various features of products that exist or may exist in the future. A conjoint survey offers a consumer a slate of alternative products and asks him or her to identify which product he/she most prefers. This survey type is known as choice based conjoint (CBC) survey. The sets of products are designed to realistically mimic the market process, whereby a consumer in an actual market is presented with various competing alternatives and chooses one of the options. The profile features are often referred to as attributes, while the values that characterize each attribute are referred to as levels. By changing the levels available for the included products and presenting each consumer with several choice sets, the researcher can determine the relative importance that consumers place on each of the attributes. Currently, most conjoint surveys—including the analysis described herein—are administered online.

14. To illustrate how a conjoint survey works, I will describe a very simple conjoint survey designed to elicit consumer preferences with respect to brands of milk that differ in their butterfat content (0%, 1.5%, or 2.5%) and price ($2, $3, or $4 per half-gallon). Such a survey might present respondents with a sequence of binary choices between bottles of milk with different profiles of butterfat content and price. The choices that respondents

[1] See for example, Allenby, Greg M. and Peter E. Rossi. (1999) "Marketing Models of Consumer Heterogeneity" *Journal of Econometrics.* 89: 57-78 and McFadden, D. (1986) "A Choice Theory to Market Research" *Marketing Science* 5(4) 275–297.

make can be analyzed to predict the market shares of milk buyers among competing products as functions of their prices.

15. While one could ask a respondent directly what value s/he places on butterfat content in milk, customers typically find it difficult to answer such questions accurately. This difficulty arises partly because such an exercise asks them to think about their preferences in a way that is unfamiliar to them. CBC surveys enable us to obtain information about the choices people make and the drivers of their behavior in a more reliable way because this conjoint elicitation closely parallels the experience these consumers have when they buy milk at the supermarket. A conjoint analysis can reveal consumer sensitivity to product attributes and prices that are obscured in real supermarket data because there is insufficient variation in availability, attribute levels, and relative prices of the different products.

16. CBC surveys typically require each respondent to perform between 12 and 20 "choice tasks," depending on the complexity of the product. As illustrated in the milk example above, each choice task requires a respondent to choose his/her preferred alternative from among a "choice set" of two, three, or four alternative products defined by their profiles of features. In each choice set, the respondent is asked to select the product that s/he would choose if those were the only options available. Consumers are limited in their capacity for choosing among a large number of products or attributes; however, CBC surveys with as many as five products and eight attributes are within a range that has been found to produce reliable results.[2]

17. Statistical methods termed Hierarchical Bayes estimation are used to analyze conjoint analysis data. Hierarchical Bayes methods estimate individual preferences in a manner that balances the overall information on consumer tastes obtained from all survey respondents with the focused but limited information on tastes obtained from the individual's responses.[3]

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[2] Green and Srinivasan (1990) "Conjoint Analysis in Marketing: New Developments with Implications for Research and Practice." *Journal of Marketing* 54(4): 3–19.

[3] McFadden, D. (1986) "A Choice Theory Approach to Market Research" Marketing Science 5(4) 275–297; McFadden and Train (2000) "Mixed MNL Models for Discrete Response" Journal of Applied Econometrics, 15, 447-470; Train and Weeks (2005) "Discrete Choice Models in Preference Space and

18. The respondents' choices from the CBC study can be used to compute their valuations for attribute levels of interest. To see how respondents' choices can be used to determine these valuations, return for a moment to the milk example. The Hierarchical Bayes method can be used to estimate taste parameters, termed "part-worths" for each individual respondent that determine the probability that people like this will choose 1.5% milk rather than 0% milk or 2.5% milk,

$$\text{Probability of 1.5\% rather than 0\% or 2.5\%} = \frac{\exp(\alpha(\gamma_{1.5}-p_{1.5}))}{\exp(\alpha(-p_0))+\exp(\alpha(\gamma_{1.5}-p_{1.5}))+\exp(\alpha(\gamma_{2.5}-p_{2.5}))},$$

where $p_{0,}$ $p_{1.5}$ and $p_{2.5}$ are the prices of these types of milk, $\gamma_{1.5}$ and $\gamma_{2.5}$ are part worth parameters for this individual that reflects his/her tastes for 1.5% milk relative to 0% milk and to 2.5% milk, and α is a scaling parameter that reflects the sharpness with which people like this discriminate between the products. It is also possible to combine these estimated parameters with outside information to predict the demand for 1.5% milk. The probability that people like the individual above will buy 1.5% milk on their next trip to the supermarket is

$$\text{Probability of 1.5\% rather than none or 0\% or 2.5\%} = \frac{\exp(\alpha(\gamma_{1.5}-p_{1.5}))}{\exp(\beta)+\exp(\alpha(-p_0))+\exp(\alpha(\gamma_{1.5}-p_{1.5}))+\exp(\alpha(\gamma_{2.5}-p_{2.5}))},$$

where β is an additional taste parameter. This parameter could be estimated by matching a population average of the probabilities above, evaluated at prevailing supermarket prices, and weighted to reflect the composition of supermarket customers, with the share of real supermarket customers who buy 1.5% milk. Alternately, the β parameter could be estimated within the conjoint analysis by including in the conjoint offerings an "outside option" of not purchasing milk. It is unnecessary to incorporate an "outside option" in a conjoint analysis to determine part-worths for relative features of products, and I do not do so in the study of music streaming services conducted here.

19. As in the milk example, one can use the results of a conjoint survey to determine how much each attribute of the product or service contributes to customers' overall valuation of the product, its "part-worth." In the current context, the part-worths allow us to

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Willingness-to-Pay Space," in The Economics of Non-Market Goods and Resources, vol. 6. Dordrecht and New York: Springer; Allenby, Greg M. and Peter E. Rossi (1999) "Marketing Models of Consumer Heterogeneity" Journal of Econometrics 89: 57-78.

determine the value that consumers place on those features not available under the statutory license, for example, for services like Spotify which allow consumers to listen to a particular music selection on demand.

V. SURVEY DESIGN AND ADMINISTRATION

20. The following section gives an overview of the survey questionnaire that I developed to elicit consumers' values for the various features of music streaming services. It also explains how the sample was selected and my survey methodology and implementation. Finally, I include statistics of the actual consumers who participated in the survey.

Overview of Conjoint Questionnaire to Elicit Valuation of Features of Music Streaming Services

21. As discussed above, my assignment was to conduct a survey in order to assess consumers' valuations of the various attributes of music streaming services. As particularly relevant to this proceeding and, as I understand, Dr. Rubinfeld's analysis, I focused on those features not available under the statutory license. To construct this survey and design a conjoint study, I instructed Brattle staff to research the attributes of music streaming services discussed in articles and music streaming services' marketing materials during 2013 and 2014. This research helped me to identify the appropriate attribute levels to include in the survey.[4]

22. I ultimately included eight attributes in the conjoint survey: (1) the playlist generation method; (2) the features available for streaming to a computer; (3) the ability to listen to music offline; (4) the features available for streaming music to mobile devices; (5) the ability to skip songs; (6) the music library size; (7) advertising embedded in the music stream; and (8) price. In order to keep the survey easy to understand, some of the levels of platforms' attributes were described in simple terms. These attributes and their associated levels are described in Table 1.

[4] For example, I identified the different types of playlist generation methods that services use. I also observed that 6 skips per hour is a typical limit for services that impose a skip limit.

Table 1: Platform Attributes and Levels

Attribute	Definition	Levels
Playlist generation method	Playlists offered to a user can either be curated by music tastemakers (such as Beyoncé or Rolling Stone Magazine) or generated by a computer algorithm customized by the user's preferences or feedback (often provided by "like" or "dislike" votes).	• Curated by music tastemakers • Generated by a computer algorithm customized by your preferences • Curated by music tastemakers and generated by a computer algorithm customized by your preferences
Features available for streaming to a computer	Using desktop software or a web interface from a computer, users may be able to access playlists generated by the streaming service and/or play specific tracks "on demand." With "on demand" features, users can listen to particular tracks (songs) or an entire album on request and users can create their own playlists.	• Playlists generated by the service • Playlists generated by the service and Album, artist, and song selection on demand
Ability to listen offline	Users can download and listen to a selection of the service's music when internet access is unavailable.	• Not available • Available
Features available for streaming to mobile devices	Users may be able to use the music streaming service on mobile devices, such as phones and tablets. The music streaming service may limit the features that are available on mobile devices. Users may be able to access playlists generated by the streaming service, pick the artist or album but hear tracks in a random order, and/or play specific tracks "on demand." With "on demand" features, users can listen to particular tracks (songs) or an entire album on request and users can create their own playlists.	• Not available • Playlists generated by the service • Playlists generated by the service and Albums and artists chosen by you, but tracks are played in a random order • Playlists generated by the service and Album, artist, and song selection on demand
Ability to skip songs	Users can skip tracks (songs) that they do not want to hear and continue to the next track.	• Up to 6 skips per hour • Unlimited ability to skip tracks
Music library size	The number of tracks (songs) available in the service's database	• 1 million songs • 10 million songs • 20 million songs • More than 20 million songs
Advertising	Plans may be ad-free or may have advertising breaks in between tracks	• 1.5 to 3 minutes of ads per hour • No ads
Price		• Free • $1.99 to $12.99 in $1 increments

23. Two attributes that distinguish webcasting services from on demand services are: (i) the features available for streaming on a mobile device—specifically whether "on demand" is available and (ii) the features available for streaming on a computer—again specifically whether "on demand" is available. My survey is focused on eliciting consumers' valuations for the availability of the "on demand" feature on their computer and mobile devices. Two other attributes that distinguish statutory webcasting from on demand services are the user's ability to skip an unlimited number of music selections and to listen to music "offline." The remaining attributes are included to accurately represent the other features present in a streaming service.

24. As noted above, CBC surveys typically require each respondent to perform between 12 and 20 "choice tasks," depending on the complexity of the product. In this conjoint survey, respondents were given 15 choice tasks. Each choice task required the respondent to choose his preferred alternative from among a "choice set" of three alternative product profiles; each profile was comprised of selected levels of the attributes listed in Table 1.

25. Table 2 gives an example of a choice set provided to an individual respondent. As shown in this table, the choice set is displayed with three columns corresponding to the offered products and eight rows to indicate the levels of the eight attributes (including monthly subscription price) for each product. The order of the attributes in the table for any participant was randomized to eliminate any design effects from the displayed order of the attributes. The levels of features and price were set by experimental design to provide suitable variation in plans to ascertain the values that respondents place on various features. The design also respected natural restrictions on feature combinations. For example, a plan could not have offline listening features, which require a mobile device, without also having the capability of listening to the service on such a device. If the respondent was a current subscriber to Pandora or Spotify, their current plan was included in each of that brand's choice sets and was indicated as such.

Table 2: Example of a Choice Display

Features	Plan A	Plan B	Plan C
Available library size *definition*	1 million songs	10 million songs	20 million songs
Mobile device streaming *definition*	Not available	Playlists generated by the service Albums and artists chosen by you, but tracks are played in a random order	Playlists generated by the service Album, artist, and song selection on demand
Playlist Method: *definition*	Curated by music tastemakers	Curated by music tastemakers Generated by a computer algorithm customized by your preferences	Curated by music tastemakers Generated by a computer algorithm customized by your preferences
Price *definition*	Free	$6.99 per month	$12.99 per month
Advertising *definition*	1.5 to 3 minutes of ads per hour	No ads	No ads
Skip limits *definition*	Limit of 6 skips per hour	Limit of 6 skips per hour	Unlimited ability to skip tracks
Offline listening *definition*	Not available	Not available	Yes
On-demand track selection *definition*	Playlists generated by the service	Playlists generated by the service Album, artist, and song selection on demand	Playlists generated by the service Album, artist, and song selection on demand
	Plan A	**Plan B**	**Plan C**

26. Although brand is not an attribute listed in Table 1, I controlled for consumers' valuation of brand—Spotify, Pandora, or an unknown brand—as follows.[5] The respondent was presented with: (i) five choice sets in which s/he was required to choose among hypothetical (or actual) Spotify products; (ii) five choice sets in which s/he was required to choose among hypothetical (or actual) Pandora products, and (iii) five choice sets in which s/he was required to choose among hypothetical products of an unnamed brand. The order that these sets were presented was randomized across respondents.

27. The first plan displayed in the conjoint table was always a zero subscription price ("free") alternative, followed by two plans with positive subscription prices, with the lower-priced plan displayed in the middle column and the more expensive plan displayed in the final column. The experimental design ensured that the quality of these plans increased along

[5] I focused on Spotify and Pandora brands because they are among the most popular non-statutory and statutory streaming services, respectively. *See* Edison Research and Triton Digital (2014) "The Infinite Dial".

with the price.[6] This ordering mimicked the convenient lowest-to-highest price ordering that consumers often encounter in sales materials produced by firms to help consumers easily compare products.

28. Respondents were asked to choose their most-preferred alternative among the three alternatives presented. Hence, the survey generated a sequence of fifteen preferred plan choices per respondent. A sample of 983 was drawn from a panel of U.S. residents over 13 years of age. With fifteen completed choice tasks per respondents, this produced information on a total of 14,745(=983 x 15) choice tasks.

Sample Selection

29. The survey targets a population of the U.S. population over the age of 13 with exclusions for respondents with household members who were employed by an online streaming music service, a record company or other owner of copyrighted music, or a marketing research firm.[7] The market research firm YouGov® conducted the survey during the first two weeks of August 2014, recruiting 906 households with a respondent aged 18 or older. This sample was supplemented in early September 2014 with a survey of 77 respondents aged 13–17. I requested a sample with specific proportions of respondents in particular age groups (13–17, 18–29, 30–39, 40–49, and 50+) who were and were not current users of streaming music services. This stratification ensured that I would have a sufficient sample of active users who were willing to pay for online streaming music services to precisely calculate the values of the features presented in the survey. YouGov provided a set of population weights that allowed me to scale this population to accurately reflect the overall U.S. population.[8]

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[6] I used a "fractional factoral" design that randomized on the attributes of the zero subscription price option, then randomly choose from the attribute levels that exceeded the levels chosen for the zero price alternative. The alternatives for the highest priced option were chosen similarly. Hence, a higher-priced product may be better on some attributes and no worse on the others.

[7] Because of the ongoing CRB proceeding, I wanted to exclude households that may have had an incentive to bias the research results. Similarly, I exclude households where marketing professionals who are familiar with conjoint surveys may seek to influence the results.

[8] The sample was stratified by age category (13-17, 18-29, 30-39, 40-49, 50+) and whether or not the respondent was a current user of internet streaming services. The survey sample was weighted to match the demographics of the 2012 Current Population Survey Internet Use supplement and the NPD Group Report (2013) "Music Streaming Survey" published by the RIAA. (http://riaa.com/media/179F6A9B-

30. Potential respondents for the surveys were identified by YouGov, a company that has pre-recruited potential respondents who have indicated their willingness to participate in market research surveys.[9] The "YouGov Panel" has nearly two million potential respondents across 11 countries and is selected to represent a broad spectrum of demographic/socioeconomic groups.[10] Over one million respondents reside in the United States. YouGov manages hundreds of projects for a variety of clients at any given time. Their political polling was recognized for its accuracy during the 2012 election cycle[11] and their studies have appeared in many academic journals.

31. Using demographic information, YouGov was able to target survey invitations to people in the appropriate demographic categories for this study. Respondents received an initial e-mail invitation and one e-mail reminder (see Appendix B). The invitation included a link to the actual survey, which was hosted on a site maintained by YouGov. This link contained an embedded identification number that assured that only invited respondents could answer the survey and that each respondent could complete the survey only once.

42EB-F309-8382-5AB1E00D7C29.pdf). Weights are propensity score weights based on age, gender, race and educational attainment (with the exception of the 13-17 cohort which used only age, race and gender).

[9] The primary method of recruitment for the YouGov panel is Web advertising campaigns that target respondents based on their keyword searches. In practice, a search in Google may prompt an active YouGov advertisement inviting their opinion on the search topic. At the conclusion of the short survey respondents are invited to join the YouGov panel in order to directly receive and participate in additional surveys. After a double opt-in procedure, where respondents must confirm their consent again by responding to an email, the database checks to ensure the newly recruited panelist is in fact new and that the address information provided is valid. Additionally, YouGov augments the panel with difficult to recruit respondents by soliciting panelists in telephone and mail surveys. For instance, in the fall and winter of 2006, YouGov completed telephone interviews using RDD sampling and invited respondents to join the online panel. Respondents provided a working email where they could receive an electronic invitation and confirm their consent and interest in receiving and participating in YouGov Web surveys. YouGov also employed registration based sampling, inviting respondents to complete a pre-election survey online. At the conclusion of that survey, respondents were invited to become YouGov members and receive additional survey invitations to their email address. YouGov also conducted telephone-to-Web recruitment in the fall and winter of 2010. By utilizing different modes of recruitment continuously over time, this ensures that hard-to-reach populations will be adequately represented in survey samples. Participants are not paid to join the YouGov panel, but do receive incentives through a loyalty program to take individual surveys.

[10] http://research.yougov.com/about/our-panel/

[11] Los Angeles Times, "Which pollsters did best: Non-traditional methods were standouts" November 8, 2012.

Survey Methodology

32. In designing and implementing the survey, I followed standard scientific methods to maximize the reliability of the survey instrument. My survey design adopted the scientific guidelines for surveys conducted for academic, commercial, and litigation purposes. I describe my methodology in greater detail below. For the full sequence of survey questions see Appendix B.

Double Blind Design

33. It is standard survey practice to conduct a "double blind" survey—that is, one that avoids indicating the sponsor and/or purpose of the survey to ensure respondents' objectivity.[12] The design and administration of my survey can be characterized as blind to the respondent (as evidenced by telephone interviews of respondents to the pilot sample). Because the survey was administered via the internet, respondents were not exposed to human interviewers, thereby eliminating the possibility of an interviewer communicating the sponsor or purpose of the survey and influencing the outcome (intentionally or not). An internet-based survey removes or at least greatly diminishes any interviewer bias which might arise from the desire of the respondents to please, displease, or impress the interviewer.

Introductory/Screener Questions

34. The survey targets a population of the U.S. population age 13 and over with exclusions for respondents with household members who were employed in the music or marketing industries. When respondents were asked whether they used particular streaming music services, they were asked whether they used "MyStro," a non-existent service. The survey ended if a respondent claimed to have used the service. This screen ensured that respondents were answering carefully and not misremembering or misrepresenting their past use or current opinions of the services. Only four respondents choose the MyStro option from the list.

[12] See *e.g.*, Diamond, Shari S. (2011). "Reference Guide on Survey Research."

Rotation of Answer Options

35. In closed-ended questions with several answer options, respondents might be more likely to choose an option simply because it is the first or last in the list. To mitigate order effects, I rotate the order of attributes presented in the conjoint card to the respondents. I also randomize the order of the plan brands (*i.e.*, Spotify, Pandora, other) presented to the respondents. I test for ordering effects by running my model separately for each of the first five, the middle five, and the final five choices faced by each respondent and find that results are qualitatively similar.

Incentive Alignment

36. In conjoint surveys, it is important to align the respondent's incentives with incentives they would face in the actual market to ensure they accurately reveal their preferences.[13] For their participation in the survey, respondents were offered a combination of a VISA gift card and a gift card to a music streaming service. The method of remuneration was tied to the choices made by respondents in order to make their incentives similar to those in the market for music streaming services.

37. To frame the incentive to the respondents, they are told:

> We will use a computer algorithm to understand your preferences for streaming music services. We will give you a gift that has a dollar value of $30 ***in total***. Based on your streaming music preferences in this survey, we will select a music streaming service among the ones currently available and give that to you, deducting its actual cost from the $30. Then we will give you the remaining amount as a VISA gift card.…
>
> **To guarantee that you get a streaming service that is worth more to you than its cost, try to weigh service features and costs carefully and accurately so that the choices you indicate tell us whether various features of streaming service plans are truly worth their cost.** [emphasis in original]

38. The idea is simple: If respondents indicate through their choices that they are truly willing to pay at least $X for a music streaming service with features similar to those offered by the Pandora paid subscription and $X exceeds the actual subscription price, then they are better off with a $30 Pandora subscription than $30 in the form of a Visa

[13] Ding, M. (2007). "An Incentive-Aligned Mechanism for Conjoint Analysis" *Journal of Marketing Research*, Vol.44, 214–223.

gift card and vice versa.[14] If their choices misrepresent their true willingness to pay, there is a chance that they will end up with a package that is worth less to them than the $30. Therefore, they have an incentive to be accurate in their statements about willingness to pay for various streaming service features.

39. This approach provided a direct incentive for respondents to carefully consider their choices. If a respondent simply chose the most fully-featured plan irrespective of price, then s/he was likely dissatisfied with the service that s/he was given as compensation for completing the survey. The respondent was incentivized to balance the features and the costs of the plan, as s/he would do in an actual marketplace.

Survey Implementation

The Pilot Survey

40. Conjoint studies must be designed carefully to ensure that choices made by respondents in the study reflect choices that would be made in the market. Before launching the final survey that I use to inform the conclusions that I offer in this report, I commissioned a pilot study of approximately 50 respondents using a draft of my survey design. The pilot concluded with 52 respondents, 22 of whom agreed to be contacted by my staff to discuss the survey. While all 22 were called, 9 were reached successfully.

41. The nine respondents were asked whether they understood the choice tasks generally and whether there were any attributes that they considered important that they had not been asked about. The nine respondents were all familiar with music streaming services and they did not identify any attributes other than those that they had been asked about as important to them in choosing among streaming music services. This reaction indicates that the survey study design captures the features that distinguish streaming music services in the marketplace in the minds of consumers. In addition, none of these pilot participants stated that they had become bored with the presentation of the choice tasks or found the survey too lengthy. Based on their responses, however, I simplified the

[14] Spotify gift cards proved to be unreliable to obtain and transmit to survey respondents, so Pandora gift cards were used exclusively. Respondents did not know they were getting a Pandora gift card (rather than a gift card to a different streaming music service) when they took the survey.

description and number of levels of the playlist attributes and simplified the language about incentives.

The Final Survey

42. YouGov administered the survey during the first two weeks of August of this year. A second wave was administered targeting the population aged 13-17 during the first two weeks of September. The sample of 983 respondents was recruited to finish a two-part survey. In the first part of the survey, respondents were asked to provide background information about the activities that they do online and how they currently use streaming music services, if they do at all. The respondents were also asked basic screening questions. At the end of the initial survey, respondents were encouraged to try the free or trial versions of both the Pandora and Spotify music services in order to gain experience with the product features if they are unfamiliar with the services or to refresh their experience with the services if they are current or past users of these platforms. After 2–3 days of potential use of the services, respondents returned to complete the second part of the survey.

43. Once the survey respondents returned to the second part of the study, it began with the description of the incentive payment described above and then moved to defining the terms that described the various levels of the seven features that would describe the various streaming music services. Respondents were then presented with fifteen choice exercises. The choices were organized in sets of five where each set was branded either as "Pandora," "Spotify," or "Unknown." The order of the sets was randomized for each respondent.

44. For the first wave of the survey (targeting the adult population), 5,163 YouGov panelists were sent an email invitation. Of the 3,598 who followed the link in a timely manner, 1,419 of these completed part A. This number not only excludes those who did not finish, but those who were deemed ineligible because of the industry in which they or a member of their household worked or because the quota for their demographic had been filled. After 2 days, those respondents who completed part A were invited to return, and 906 completed part B. The respective figures for the second wave (targeting teenagers) were 1,255, 574, 239, and 77 completes. Table 3 below shows the breakout of the sample

through each phase of the process. After the initial nonresponse, the largest category of attrition in the survey process was the fulfillment of quotas for the stratified sample.

Table 3: Disposition of Sample Respondents

	Adults	*Teens*
Total Contacted:	5,163	1,255
Total Who Started Part A:	3,598	574
Total who Completed Part A (excludes ineligible respondents and those who declined or did not complete the survey):	1,419	239
Total Who Finished Part B:	906	77
Completes Over Part A Finishers	64%	32%

45. The final sample was stratified so that two-thirds of respondents had used a music streaming service within the last year. Of those who had used a service in the last year, respondents were asked which platform they used. The platforms that respondents identified are shown in Figure 1 below. As is evident from Figure 1, Pandora is the most ubiquitous platform, followed by YouTube, then Spotify. When there is a free and paid version of the same platform, consumers choose the free version decisively over the paid version.

46. Paid services were identified when respondents affirmatively identified their plan as paid at a particular price point. If the respondents were unsure or chose "another plan," they were not counted as a paid service. The counts are listed as a percentage of all those who had experience with music streaming. Because many people subscribe to more than one music streaming service, the percentages across all platforms sum to more than 100 percent.

47. The frequency with which respondents reported using their services is shown in Figure 2 below. This figure shows a bi-modal distribution with many users utilizing these services frequently, but with a reasonable number of "casual" users who use the service less than six days a month.

Figure 1: Streaming Services Used

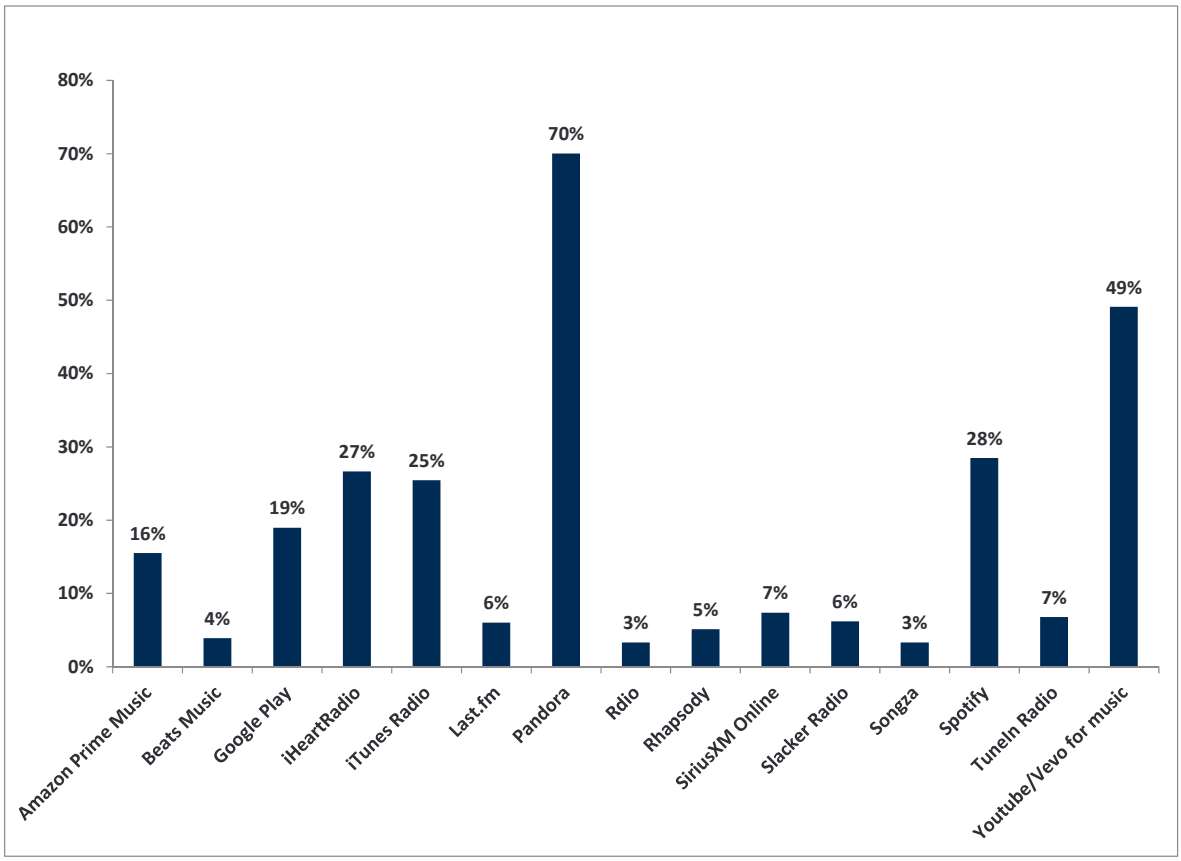
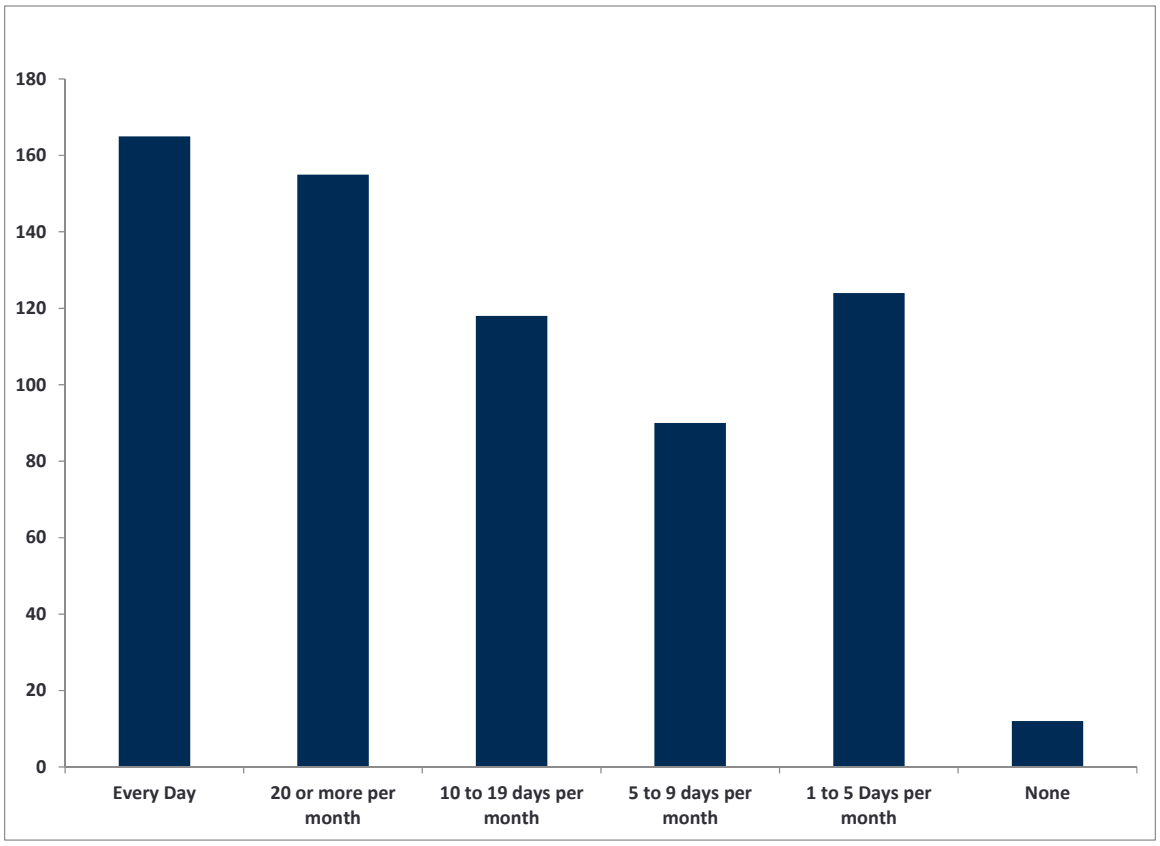
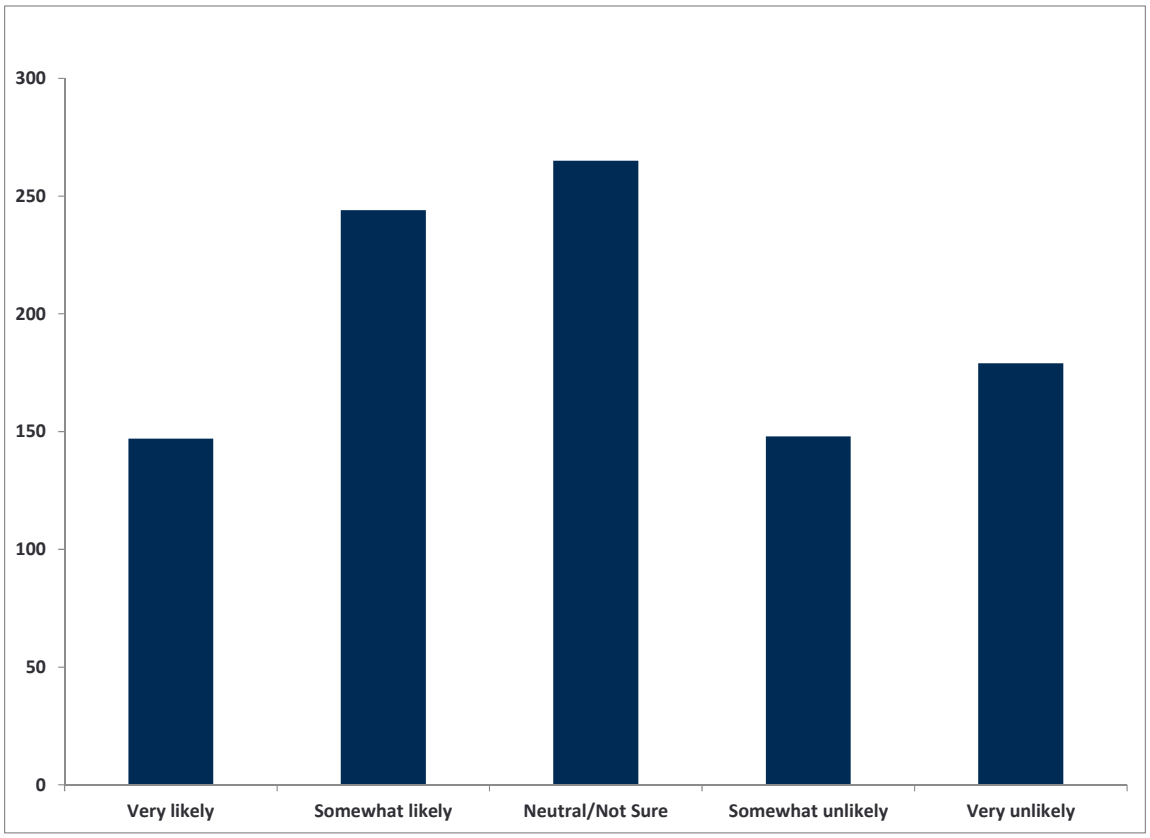


Figure 2: Frequency of Use



48. After the respondent answered all the choice questions, they were asked how likely they were to subscribe to a paid music streaming service in the future if their favorite of the options in the survey was offered. The choices offered were five categories ranging from "Very likely" to "Very unlikely." The frequencies of responses are given in Figure 3 below. Hence, while the observed choices of the respondents suggest a strong preference for platforms that require no out-of-pocket expense, they remain open to the possibility of paying for a service in the future. Respondents were also asked about the likelihood of using a free service; most individuals responded that they were somewhat or very likely to use a free service.

Figure 3: Likelihood of Subscribing to a Paid Service



VI. ESTIMATION OF PART-WORTHS

49. To analyze the responses to the conjoint study, I use what economists and marketing analysts call "discrete choice models." These models are commonly used to predict consumer choices among competing products. At their core, discrete choice models assume that consumers choose the product from among a set of alternatives that gives them the most value (or "utility" in economics jargon) net of the cost of the product. I used a value function, known as a "random utility model," that relates the desirability of a particular choice to the level of its various attributes, specifically:

$$u_{jrk} = (x_{jrk}\gamma_j - p_{jrk})\alpha_j + \nu_{jrk},$$

where j = 1,…,J indexes the respondents in the sample, r = 1,…,R with R = 15 indexes the choice offerings each respondent is given, and k = 1,…,K with K = 3 indexes the alternatives in each offering. In this equation, x_{jrk} is a vector of the stated features of plan k offered to respondent j in offering r, defined so that in general an increase in any component of x is desirable (*e.g.*, unattractive product features enter with a negative sign,

attractive product features enter with a positive sign), p_{jrk} is the subscription price of plan k (which may be zero), and ν_{jrk} is a disturbance that reflects the influence of undescribed features and idiosyncratic tastes. The term α_j is a scaling factor that captures the importance of described factors versus un-described factors for respondent j, and γ_j is a vector of coefficients, denominated in dollars, that measure this respondent's willingness to pay for the corresponding described features. In market research, the γ_j coefficients are termed "part-worths."

50. Practical implementations of this approach assume a distribution of the undisclosed factors ν_{jrk} and distributions for the parameters α_j and γ_j. A particularly useful formulation of this random utility model is called the logit model; this model underlies the analysis that I present in this report. I estimated logit models using the features presented to respondents in the conjoint table.

51. The logit model follows from an assumption that the disturbances ν_{jrk} have a specific statistical form: independent and identically distributed with a type 1 extreme value distribution. While this appears to be quite restrictive, it is not when the parameters (α_j,γ_j) can vary across respondents, as any behavior explainable by a random utility model can be explained by a model of this form.[15] In my analysis, I estimate different versions of the same model specification with different assumptions about how different people value different features of the various services. The details of the model are given in Appendix C.

52. My primary results are estimated using a Hierarchical Bayesian approach that is widely used in market research to analyze data from conjoint surveys. These models permit me to estimate separate willingness to pay values for each survey respondent. This is important for my survey design because the sample was stratified, rather than drawn completely at random. To generate average willingness to pay values for a population of interest, I calculate a weighted average of the willingness to pay for each respondent, with the weights chosen to reflect the stratification approach and the relevant population.

[15] McFadden and Train (2000) "Mixed MNL Models for Discrete Response" *Journal of Applied Econometrics*, Vol. 15 447-470.

53. The γ_j coefficients provided by this model give the dollar value for willingness to pay for each level of each feature for each respondent. These estimates allow me to quantify which feature changes most alter the perceived value of a streaming music service. The model allows me to place a dollar value on certain changes in the feature set between two plans. This dollar value is calculated by taking the difference between the non-price features of two streaming music plans. As a particular example, supposing that two plans only differed in the ability to listen to music offline, then the coefficient of part-worths on this feature gives the dollar value to consumers of offline listening.

VII. RESULTS

54. The results of my survey show the average willingness to pay for the various features. These are the "part-worths," described above, estimated using the Hierarchical Bayesian method. These results are given in Table 4 below. The four columns represent the estimates over the sample targeted to different populations. The "Unweighted" column displays the results calculated from the sample of 983 survey respondents. The "Weighted US pop." column displays results that are weighted to be representative of the US population older than 12 years old as discussed above. The "Weighted, US current users" column displays results that are weighted to be representative of the US population older than 12 years old that subscribe to a free or paid streaming music service. Finally, the "Weighted US future users" column displays results for the US population older than 12 years old that are willing to use a free or paid music streaming service. This latter group is weighted for those users who are "somewhat" or "very" likely to sign up for a streaming music service in the future, as self-identified by responses to questions in the conjoint survey. I also call this group the population of "potential future users" and, as explained in the next paragraph, believe it is the population that best reflects the value of these features to consumers in the future market for streaming services.

55. I also provide the appropriate standard deviations of this distribution, showing how variable the average willingness to pay values are as the result of sampling variation

across the relevant population. These numbers are in parentheses. They are the standard errors of the posterior means.[16]

Table 4: All Features

	Unweighted	Weighted, US pop.	Weighted, US users	Weighted, US users (future)
No advertising	1.20	1.30	1.36	1.33
	(0.11)	(0.11)	(0.13)	(0.11)
Current plan	1.20	1.19	1.18	1.19
	(0.03)	(0.04)	(0.05)	(0.04)
Catalog from 1M to 10M	1.34	1.35	1.34	1.34
	(0.01)	(0.01)	(0.02)	(0.01)
Catalog from 1M to 20M	1.57	1.59	1.59	1.60
	(0.05)	(0.05)	(0.06)	(0.05)
Catalog from 1M to 20M+	1.51	1.54	1.54	1.52
	(0.07)	(0.07)	(0.09)	(0.08)
Playlist from tastemakers to algorithm	0.84	0.83	0.85	0.86
	(0.02)	(0.02)	(0.03)	(0.03)
Playlists from both alg. and tastemakers	0.52	0.57	0.64	0.60
	(0.04)	(0.05)	(0.06)	(0.05)
Free plan	0.28	0.33	0.30	0.21
	(0.10)	(0.10)	(0.12)	(0.11)
On demand (computer)	0.67	0.67	0.66	0.68
	(0.01)	(0.01)	(0.02)	(0.01)
Addition of mobile service	1.19	1.18	1.30	1.23
	(0.05)	(0.05)	(0.06)	(0.05)
Addition of mobile service and randomization	1.58	1.60	1.73	1.67
	(0.07)	(0.07)	(0.08)	(0.07)
Addition of mobile service with on demand	1.69	1.77	1.96	1.85
	(0.09)	(0.09)	(0.11)	(0.09)
Offline listening	1.04	1.17	1.25	1.18
	(0.07)	(0.07)	(0.09)	(0.07)
Unlimited skips	1.37	1.40	1.47	1.41
	(0.06)	(0.06)	(0.08)	(0.07)

[16] The standard errors are calculated on the estimated posterior parameter estimates and hence do not account for the sampling variation of the individual estimates themselves. Standard errors that account for the sampling variation in the individualized coefficients could be done through a simple bootstrap procedure.

56. The population of potential future users was chosen because the market for music streaming services has grown rapidly during the last five years to the point that a significant fraction of the U.S. population now listens to music streamed over the internet.[17] Most users regard their use of these services as free in the sense that they require no out-of-pocket expenses to listen to music. Instead, the platforms earn revenues for free users through advertising. Even for those music streaming services that offer a paid subscription, most rely on advertising for a portion of their revenue. The posterior distribution of the values respondents place on a free plan shows a group of consumers who place a high value on no out-of-pocket expenses. This group also places lower values on changes to platform features. These consumers represent those who are likely to remain or adopt free plans. As the market evolves, both "free" and paid users will generate revenues for the streaming services and future growth will come from those potential subscribers who are not yet users but are likely to consider using one of these services in the near future. Hence, the contributions of those reluctant to pay for streaming services are appropriately included in the population of likely future users.

57. Due to the specification of the scaling factor discussed above, the units of the coefficients are in dollars per month for all these statistics. The coefficients reflect the average value of each of the levels of the features relative to baseline levels. The levels of the features are entered in the estimated model as deviations from the following baseline levels: (1) no "on demand" feature for a computer; (2) no ability to use the service on a mobile device; (3) no "offline" capability; (4) advertising present; (5) not the respondent's current plan; (6) a catalog of 1 million songs; (7) playlists generated by tastemakers; and (8) skips limited to 6 per hour. For example, the increase to 10 million songs from the baseline of 1 million songs on a platform is valued at $1.34 on average over the U.S. population of potential future users.

[17] See Edison Research and Triton Digital (2014) "The Infinite Dial."

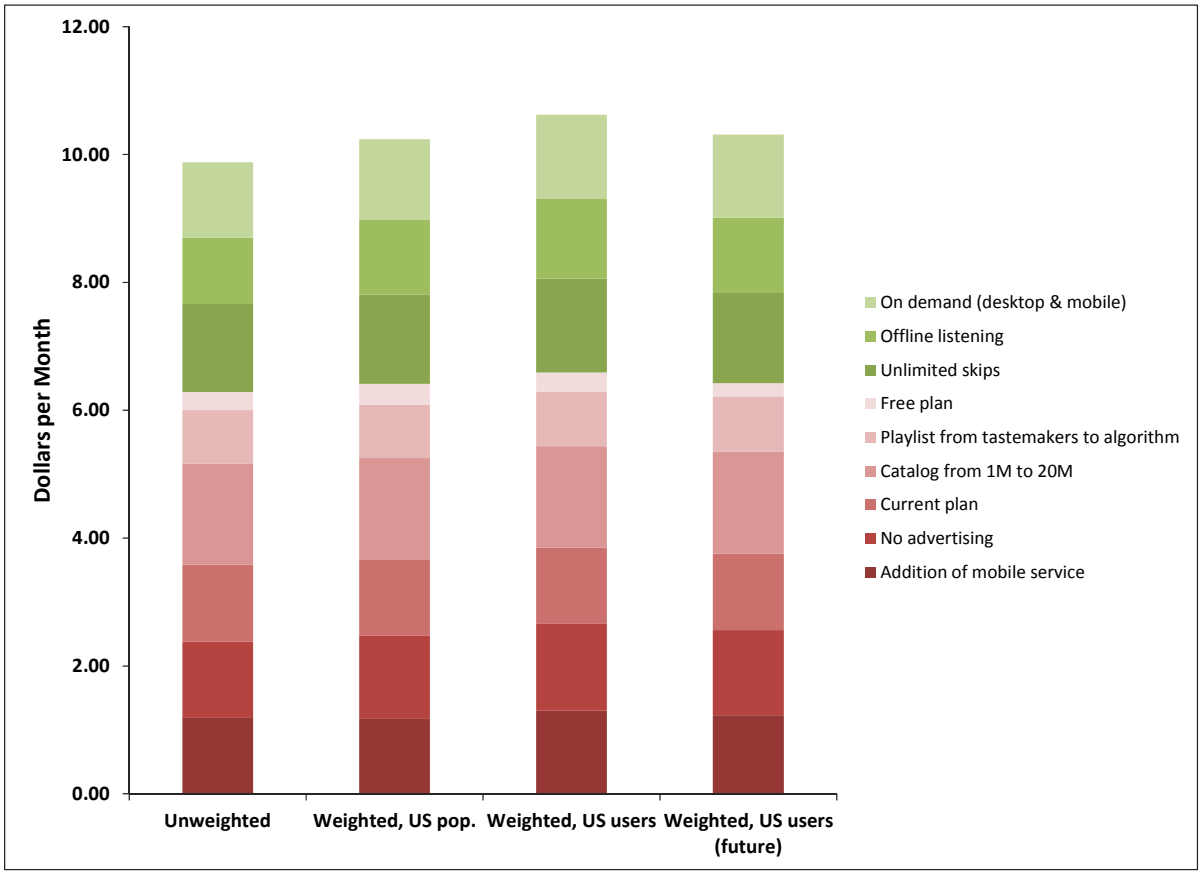
58. Table 5 presents estimates for the total value of the on demand feature (considering both computer and mobile offerings) and two other features potentially relevant for a non-statutory service: offline listening and an unlimited ability to skip tracks. The total value of on demand is calculated by summing the value of computer on demand services ($0.67 in the U.S. population and $0.68 for potential future users) and the incremental value of mobile services with on demand features relative to mobile service with playlists only ($1.77 - $1.18 = $0.59 for the U.S. population and $1.85 - $1.23 = $0.62 for potential future users).

Table 5: Non-statutory Features

	Unweighted	Weighted, US pop.	Weighted, US users	Weighted, US users (future)
Total value of on demand (computer & mobile)	1.18	1.26	1.31	1.30
	(0.05)	(0.06)	(0.07)	(0.06)
Offline listening	1.04	1.17	1.25	1.18
	(0.07)	(0.07)	(0.09)	(0.07)
Unlimited skips	1.37	1.40	1.47	1.41
	(0.06)	(0.06)	(0.08)	(0.07)

59. The relative value of each of the features is shown graphically below in Figure 4. The green shaded categories denote those features that I understand are not available for statutory services. The red shaded categories relate to the features that are available to both statutory webcasters and streaming services that have directly negotiated licenses. The vertical scale is dollars per month.

Figure 4: Non-statutory and Other Features



60. The valuations shown in the tables above represent the average valuation given by respondents to the changes in features shown. For a particularly highly featured platform, the values give the monetary offset necessary so that the removal of a feature from the platform combined with a discount would be viewed as just as desirable as the platform was prior to the change on average by the population of potential future users. However, because the values vary across the population, roughly half the population will view the new configuration as inferior while roughly half the population will view the new configuration as superior.[18] As noted above, I report results in Table 4 for four different populations. Because the valuations of different features vary across the population, for a given set of offerings, those with the highest valuations for the features offered by a particular service will sign on to that service. On the other hand, those members of the population that have the lowest valuations for the features offered by music streaming services are unlikely to become subscribers to any service. Hence, the valuations will increase the more the population is segmented towards intensive users of music streaming services. The population of potential future users I use is broad enough to include those who use the services currently and those who, after being offered the opportunity to try the services, indicate they are at least somewhat likely to use or subscribe to a service in the future.

61. In order to understand these estimated valuations, it is useful to look at the relative values of plans with different configurations of features. For example, if one wanted to compare a premium on demand plan with one that was limited to those features available under the statutory license, it would be appropriate to add up those features that make up the difference between the plans and compare it to the value of all the premium attributes. For example, suppose two plans which offered mobile platform support were identical except that one plan had on demand for both mobile and computer, offline listening, and unlimited skips but the other platform did not. Assume the platforms shared a catalogue size of 20 million, supported playlists chosen by tastemakers and a computer algorithm, and neither had advertising. Among the population of potential future users, the value of

[18] The proportions would be exactly half if the results were described by the median valuation. The posterior distributions of the sample are not dramatically long tailed so that the means and medians are not very different.

those features lacking in the inferior platform is equivalent to a discount of $3.89 per month on the subscription price on average. The value of the remaining common features is $4.66 (the sum of the part-worths for the 20 million catalogue size, no advertising, and mobile device support). Hence 45% = (3.89/(4.16+3.89+0.60)) of the value to future consumers is attributable to the non-statutory features.

VIII. CONCLUSIONS

62. The survey results described in this report show that potential and current users of music streaming services ascribe value to the variety of features that are available on both statutory webcasting services and services offering on demand streaming. The potential future users of music streaming services on average put a value of $1.30 per month for the functionality of "on demand" access to music (for both computer and mobile devices). The average value potential future users put on the ability to listen to music offline is $1.18 per month and the average value of having unlimited skips is $1.41 per month. Other features of value for potential and current users include the ability to forgo advertisements ($1.33 per month) and increasing the size of the music catalogue ($1.60 per month). These values illuminate consumer preferences and the relative values between different streaming music plans offered in the market.

I declare under penalty of perjury that the foregoing testimony is true and correct to the best of my knowledge and belief.

Date: Oct. 6, 2014 Daniel L McFadden

Daniel L. McFadden

APPENDIX A: RESUME OF PROFESSOR DANIEL L. MCFADDEN

Daniel L. McFadden
Principal

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Professor Daniel McFadden is a principal with The Brattle Group, which provides consulting services and expert testimony on economic, finance, regulatory and strategic issues to corporations, law firms and public agencies worldwide.

Professor Daniel McFadden, recipient of the 2000 Nobel Prize in Economics, is the E. Morris Cox Professor of Economics at the University of California at Berkeley and was previously the James R. Killian Professor of Economics at MIT. He was awarded the Nobel Prize for his numerous contributions to quantitative economic science and, in particular, his pioneering theoretical, methodological, and empirical work in the analyses of discrete choices. Dr. McFadden has received numerous other awards including the John Bates Clark Medal given every two years to the American economist under the age of forty who has made the most outstanding contribution to the field of economic science. Dr. McFadden received his Ph.D. in Economics from the University of Minnesota in 1962. There he also earned his B.S. in Physics, with high distinction, in 1957.

Dr. McFadden has also held the following academic appointments:

1996-	Director, Econometrics Laboratory, University of California, Berkeley
1995-1996	Chair, Department of Economics, University of California, Berkeley
1991-1995	Director, Econometrics Laboratory, University of California, Berkeley
1990-	E. Morris Cox Chair, University of California, Berkeley
1990-	Professor of Economics, University of California, Berkeley
1990	Sherman Fairchild Distinguished Scholar, California Institute of Technology
1986-1991	Director, Statistics Center, Massachusetts Institute of Technology
1984-1991	James R. Killian Chair, Massachusetts Institute of Technology
1978-1991	Professor of Economics, Massachusetts Institute of Technology
1977-1978	Irving Fisher Research Professor, Yale University
1968-1979	Professor of Economics, University of California, Berkeley
1966-1967	Visiting Associate Professor, University of Chicago
1966-1968	Associate Professor of Economics, University of California, Berkeley
1963-1966	Assistant Professor of Economics, University of California, Berkeley
1962-1963	Assistant Professor of Economics, University of Pittsburgh
1961-1962	Instructor, Economics, University of Minnesota
1959-1960	Research Assistant, Social Psychology, University of Minnesota
1957-1958	Instructor, Physics, University of Minnesota

Daniel L. McFadden

EXPERIENCE

Dr. McFadden has had a varied background in professional and public service. Among his achievements are:

- President, American Economic Association (AEA) (2005)
- Chair, National Academy of Science (NAS) Section 54 Economic Sciences (2003-)
- Chair, NAS Committee on Methods of Forecasting Demand and Supply of Doctoral Scientists and Engineers (1997-2000)
- Advisory Committee, Journal of Applied Economics (1996-)
- NAS Commission on Science, Engineering, and Public Policy (1995-)
- Chair, AEA Committee on Electronic Publication (1994-)
- Vice President, American Economics Association (1994)
- NAS Committee on Behavioral and Social Sciences and Education (1989-1994)
- Panel Study of Income Dynamics, Advisory Board (1988-1991)
- Executive Committee, American Economics Association (1985-1987)
- President, Econometric Society (1985)
- Executive Committee, Econometric Society (1983-1986)
- Council of the Econometric Society (1983-1986)
- Vice President, Econometric Society (1983-1984)
- NAS Committee on Energy Demand Modeling (1983-1984)
- NAS Committee, Basic Research in the Social Sciences (1982-1987)
- Chair, AEA Awards Committee (1981-1984)
- Board of Directors, National Bureau of Economic Research (1980-1983)
- Editor, Econometric Society Monographs (1980-1983)
- Review Committee, California Energy Commission (1979)
- Sloan Foundation Book Committee (1977-1979)
- Executive Committee, Econometric Society (1978-1980)
- Board of Editors, Transportation Research (1978-1980)
- Associate Editor, Journal of Econometrics (1977-1978)
- Board of Directors, National Bureau of Economic Research (1976-1977)
- Executive Committee, Transportation Research Board (1975-1978)
- City of Berkeley, Coordinated Transit Project (1975-1976)

- Advisory Committee on Transportation Models, Metropolitan Transportation Commission (1975)
- Council of the Econometric Society (1974-1980)
- Elected Member, Universities National Bureau (1974-1977)
- Board of Editors, Journal of Mathematical Economics (1973-1977)
- Board of Editors, American Economic Review (1971-1974)
- Chair, NSF-NBER Conference, Economics of Uncertainty (1970-)
- Economics Advisory Panel, National Science Foundation (1969-1971)
- Editor, Journal of Statistical Physics (1968-1970)

MIT – RELATED:

- Committee on Curricula, 1990-91
- Killian Award Committee, 1984
- Center for Energy Policy Research, Program Board, 1983-84
- Engineering Dean Search Committee, 1980-81
- Provost's Committee on Statistics, 1979-80
- CTS Advisory Board, 1978-79

BERKELEY – RELATED:

- Director of Graduate Studies, 1994-95
- IBER Advisory Committee, 1993-95 (Chair, 1994-95)

PROFESSIONAL AFFILIATIONS

- American Economics Association
- The Econometric Society
- American Statistical Association
- Mathematical Association of America
- Transportation Research Board

FELLOWSHIPS, SCHOLARSHIPS, HONORS, AND AWARDS

- Honorary Degree, University of Montreal (2004)
- Honorary Degree, University College London (2003)
- Richard Stone Prize in Applied Econometrics (2000-2001)
- Nobel Prize in Economics (Joint Recipient) (2000)
- Nemmers Prize in Economics, Northwestern University (2000)
- American Agricultural Economics Association, Best Paper Prize (1994)
- University of Chicago, LLD (1992)
- Frisch Medal, Econometric Society (1986)
- Elected to National Academy of Science (1981)
- Outstanding Teacher Award, MIT (1981)
- Fisher-Schultz Lecture, Econometrics Society (1979)
- Elected to American Academy of Arts and Sciences (1977)
- John Bates Clark Medal, American Economics Association (1975)
- Elected Fellow, Econometrics Society (1969)
- Ford Faculty Research Fellow (1966-1967)
- Mellon Post-Doctoral Fellow (1962-1963)
- Earhart Fellow (1960-1961)
- Ford Foundation Behavioral Science Fellow (1958-1962)

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EXPERT TESTIMONY & CONSULTING

In an administrative law case, *U.S. DOE vs. Cities Service Corp*., I prepared written testimony and testified in support of defendant Cities on alleged damages from overcharges. My analysis considered the issue of the marginal cost of production of "new oil" and the econometric techniques appropriate for this analysis. (1987)

In the patent damages case of *Polaroid v. Kodak,* I served as a consulting expert to Polaroid on the economic theory of the case and the methodology used to estimate damages. (1989)

In the case of *U.S. DOJ vs. Exxon Company USA*, arising from the Exxon Valdez oil spill, I prepared for Exxon estimates of damages from loss of recreational opportunities. I was not deposed and did

not testify prior to settlement of the case. However, I subsequently testified before a NOAA rule-making committee on some aspects of environmental damage assessment. (1990-1992)

In the case of *Northern Industries vs. Portec*, a contract dispute, I analyzed the market for railroad cranes on behalf of defendant Portec to determine whether the plaintiff was damaged, and critiqued a NERA analysis. I was deposed and testified. (1991-1994)

On behalf of defendant Atlantic Richfield Company, I submitted an expert report and was deposed in the case of *State of Montana vs. ARCO*, which involved contamination of streams arising from historical smelter operations of Anaconda Copper Company. My analysis considered the valuation of damages to consumer welfare from the contamination. (1993-1998)

I was deposed and testified on behalf of the defendants in the Industrial Excess Landfill case, a class action against Goodyear, Goodrich, and Firestone Rubber companies. My analysis focused on the estimation of damages from stigma. (1994-1995)

I was deposed in the case of *Apple Computer vs. ICSOP*. On behalf of the defendants, I analyzed the economic basis for allocation of a settlement between Apple Inc. and Apple Computer in a case involving trademark infringement and licensing of future use. (1995)

I submitted an expert report and was deposed in a case alleging unjust enrichment from trade secrets, *American Airlines vs. Northwestern Airlines*. On behalf of the defendant, I critiqued the damage analysis of the plaintiff=s experts. (1997)

I submitted an expert report, was deposed, and testified on behalf of Globe Metallurgical who was a defendant in a price-fixing civil anti-trust suit in the ferrosilicon products industry. My analysis focused on the reliability of the methodology used to detect whether plaintiffs were damaged. (1998)

I was a member of a three-person mediation team that mediated a suit in which the State of California and others were the plaintiffs and Bank of America was the Defendant. The case involved damages to the State from a failure of the Bank to return funds from inactive accounts. (1998)

I submitted an amicus brief to a federal appeals court in reference to a Daubert ruling on the econometric analysis of an expert in a civil suit regarding unfair business practices. The issue in that case was whether the methodology used was a reliable indicator of damage to a competitor from alleged anticompetitive conduct. (2000)

I submitted an expert report and was deposed on behalf of Northpoint Communications in *Northpoint Communications vs. Verizon Communications.* My analysis estimated the loss in the market value of Northpoint as a result of a breach of contract by Verizon. (2001)

I submitted an expert report and was deposed on behalf of DuPont in the Choline Vitamins price-fixing litigation. My analysis estimated damages from the alleged anticompetitive conduct. (2001)

I submitted an expert report and was deposed on behalf of General Electric in *State of New Mexico ex rel, vs. General Electric, et al.* Case number CV 99-1254 BSJ and CV 99-1118 BSJ. The case

involved the estimation of stigma damages. I submitted an amicus brief to the United States Supreme Court on this issue. (2002)

I submitted an expert opinion and was deposed and testified on behalf of Visa USA in a class-action litigation regarding pricing of foreign exchange services for credit card users. *Schwartz vs. Visa International, et al*, Case number 822404-4. (2002)

I submitted an expert report and was deposed on behalf of Cellnet of Ohio in *Westside Cellular Inc. dba Cellnet of Ohio vs. New Par et.al.* My analysis estimated damages from alleged illegal pricing of access to a telecommunications network. (2002)

I was retained as the damages expert in a patent infringement case involving reasonable royalties for an electronics invention. The case was dismissed. (2002)

I was retained as the damages expert by AOL in the *Netscape v. Microsoft* antitrust case. This case settled prior to submission of an expert report. (2002-2003)

I was retained as the damages expert by Sun Microsystems in *Sun v. Microsoft* antitrust case. This case settled prior to submission of an expert report. (2003-2004)

I testified in a private arbitration regarding damages from alleged conduct of a participant in an auction for a company. The principals and issues are confidential. (2003)

I submitted a co-authored amicus brief to the Supreme Court in reference to the regulation of interstate wine shipments. (2004)

I submitted an expert report, an affidavit, and was deposed and testified in the Rocky Flats Plant case, a class action against Dow Chemical and Rockwell. On behalf of the defendants, I critiqued the plaintiffs= and defendants damage analysis, and rendered an opinion on their reliability. (1997-2006)

I submitted an expert report and testified at trial in Australia in an antitrust matter on behalf of plaintiff in *Seven v. News Corp.*

I testified at trial on behalf of the defendants in *Pharmaceutical Industry Average Wholesale Price Litigation*, MDL No. 1456, Civil Action: 01-CV-12257-PBS. (2006)

I submitted expert reports on damages, co-authored expert reports on antitrust liability, and provided deposition testimony on behalf of the defendants in *Nitro Distributing, Inc., et al. v. Alticor, Inc., Amway Corporation, and Quixtar, Inc.* Case No. 03-3290-CV-S-RED (2007)

I co-authored a paper on behalf of Qualcomm titled "The Costs of the ITC Downstream Exclusion Order to the U. S. Economy," July 10, 2007, for the Presidential Review Phase of *Certain Baseband Processor Chips and Chipsets, Transmitter and Receiver (Radio) Chips, Power Control Chips, and Products Containing Same, Including Cellular Telephone Handsets*, USITC Inv. No. 337–TA–543.

I submitted an expert report on a patent matter on behalf of the defendants in *Every Penny Counts, Inc. v. Bank of America Corporation and Bank of America, N.A.,* Case No. 2:07-CV-42-FTM-29SPC. (2008)

I testified at trial on behalf of the defendants in *Daniels Sharpsmart v. Tyco International, et al.* (2008)

I submitted an expert report in *Jarra Creek Central Packing Shed Pty Ltd v Amcor Ltd,* Case No. (P)NSD702/2006. (2011)

I submitted an affidavit on behalf of the plaintiffs in *DIRECTV, Inc. and EchoStar Satellite LLC v Loren L. Chumley, Commission of Revenue, State of Tennessee*, Case No. 03-2408-IV (2011)

I submitted an expert report on behalf of the defendants in *Sandra Landwehr v. AOL, Inc.*, Case No. 1:11-cv-01014-CMH-TRJ. (2012)

I was retained as a statistical expert by plaintiffs in the matter of *Syncora Guarantee Inc. v. Countrywide Home Loans, Inc., Countrywide Securities Corp., Countrywide Financial Corp., and Bank of America Corporation*, Supreme Court of the State of New York, County of New York, Index no. 650042/09E, May 6, 2010. This case settled prior to submission of an expert report.

I submitted an expert report in the matter of *United States of America v. Countrywide Financial Corporation et.al.* (12CIV.1422(JSR)), May 7, 2013 and a revised report on June 6, 2013. I testified at deposition in this proceeding on June 11, 2013. I submitted an updated report on August 23, 2013.

I was retained as a consulting expert by defendant in the matter of *In RE: High-Tech Employee Antitrust Litigation,* United States District Court Northern District of California, San Jose Division, Master Docket No. 11-CV-2509-LHK. (2011)

I submitted an expert report (September 2013) and a rebuttal report (December 2013) on behalf of plaintiffs in the matter of *U.S. Airways, Inc., v. Sabre Holdings Corporation*, Civil Action No. 1:11-ev-02725-MGC

APPENDIX B: THE SURVEY INSTRUMENT

A. EMAIL INVITATION TO TAKE PART 1 SURVEY

From: "help.us" <help.us@yougov.com>
Reply-To: "help.us" <help.us@yougov.com>
Date: Thursday, September 18, 2014 11:44 AM
To: $Email
Subject: Share your opinions in a YouGov Survey

Can't read this email? Click here to view a desktop version.

YouGov® What the world thinks

Hi $InvitationName,

You have been selected to share your opinions in a new YouGov survey.

We know your time is valuable. As a way of showing our thanks, you'll be awarded at least **500 points** when you complete every survey we email you. The longer the survey, the more points you earn.

Start Now

If you cannot view or click on the button above, please copy and paste this address into your browser:

$SurveyLink

Thank you for being an active member of the YouGov community!

Kelly Connor
YouGov

For more information on YouGov visit **http://today.yougov.com**. If you have any questions please read our **membership rules** and **Privacy Policy**.

To ensure reliable delivery please add **help.us@yougov.com** to your address book.

This email was intended for $Email. YouGov does not send unsolicited emails. You received this message because you signed up to receive polls from us.

If you received this message in error or no longer wish to participate, please use the following link to unsubscribe: **https://isurvey-us.yougov.com/unsubscribe/$msgid**

E help.us@yougov.com **W** yougov.com
If you don't want to receive these emails, you can unsubscribe at any time.

B. EMAIL INVITATION TO TAKE PART 2 SURVEY

From: "help.us" <help.us@yougov.com>
Reply-To: "help.us" <help.us@yougov.com>
Date: Thursday, September 18, 2014 11:44 AM
To: $Email
Subject: YouGov Streaming Music Survey

Can't read this email? Click here to view a desktop version.

YouGov® What the world thinks

Hi $InvitationName,

Thank you for agreeing to participate in YouGov's streaming music survey. We hope you have taken time to explore the features offered by Pandora and Spotify.

For your participation in this survey, we will offer you **$30 in gift cards**.

In order to be eligible to receive the incentive, you must complete this survey within one hour of starting it. You will be prevented from moving through the questions too quickly and, if it appears that you are answering questions at random, you will not be eligible for the incentive.

Please be sure to take this survey on a desktop, laptop, or tablet computer. This survey is not compatible with smartphones due to their small screen size.

Start Now

To get started with the second part of the music streaming survey, please click on the button above. If you cannot view or click on the button above, please

copy and paste this address into your browser:

$SurveyLink

Thank you for being an active member of the YouGov community!

Kelly Connor
YouGov

For more information on YouGov visit **http://today.yougov.com**. If you have any questions please read our **membership rules** and **Privacy Policy**.

To ensure reliable delivery please add **help.us@yougov.com** to your address book.

This email was intended for $Email. YouGov does not send unsolicited emails. You received this message because you signed up to receive polls from us.

If you received this message in error or no longer wish to participate, please use the following link to unsubscribe: **https://isurvey-us.yougov.com/unsubscribe/$msgid**

E help.us@yougov.com **W** yougov.com
If you don't want to recieve these emails, you can unsubscribe at any time.

Part 1 Survey

1. Are you or any members of your household employed in any of the following industries? (Select all that apply) [Randomize order A-E; terminate if A, D, or E]

   - A marketing research firm
   - An Internet service provider
   - A video recording or production studio
   - An online streaming music service
   - A record company or other owner of copyrighted music
   - A social networking service
   - None of these

In the following questions, we are going to ask you about activities that you do online. By "online," we mean over the Internet, using a computer, tablet, smartphone, or other mobile device.

2. Which of these services have you used in the last year? (Select all that apply)

   - Social networking site (such as Facebook or LinkedIn)
   - Online dating site (such as Match.com or OKCupid)
   - Online streaming music service (such as iHeartRadio, iTunes Radio, Pandora, or Spotify)
   - Online streaming video service (such as Netflix, Amazon Instant Video or iTunes movies)
   - None of these

We are going to ask you a series of questions about your streaming music listening habits. Streaming music is music delivered to a listener over an Internet connection, including wireless (wi-fi) and cellular networks. Listening to music that you have downloaded to your computer or other device (such as an iPod) is not considered streaming music. Over-the-air (traditional) radio and satellite radio (like SiriusXM) are also not considered streaming music.

3. During the past year, which of the following did you use to listen to streaming music? (Select all that apply) [Rotate]

   - A laptop or desktop computer
   - A tablet
   - A mobile phone
   - A television set
   - Car connected technology

4. In a typical month, on approximately how many days do you listen to streaming music on any device?

   - Every day
   - 20 or more days (but not every day)
   - 10 to 19 days
   - 5 to 9 days
   - 1 to 5 days
   - None

5. Which of the following services have you used during the past year? [[For services with multiple plans, pop-up bubbles ask respondent to select plan from currently available options: "Which version have you used most recently?" Included are "A different version" and "Don't know" options.]]
   - Amazon Prime Music
   - Beats Music
   - Google Play
   - iHeartRadio
   - iTunes Radio
   - Last.fm
   - MyStro
   - Pandora
   - Rdio

- Rhapsody
- SiriusXM Online
- Slacker Radio
- Songza
- Spotify
- TuneIn Radio
- Youtube/Vevo for music

We would like to ask for your opinions about some new streaming music plans that could be offered by these services. Your answers will not be used to market any plans to you and no plans are being sold in this survey.

For your participation in this survey, we will offer you $30 in gift cards. Here's how it works. We ask that you try two particular services in the next couple of days:

- Pandora
- Spotify

Both services offer free plans and free trials of their paid plans. We will give you links to these services on the next page.

In two days, we will invite you to take the second part of this survey. The follow up survey should take no more than 15 minutes.

6. Are you willing to participate in the second survey?

- Yes
- No

Thank you for agreeing to participate in this study. You can try out the services by visiting the following links, which will appear in a new window.

Please be sure to come back to this window and finish the survey so that we know you are participating in the full study.

Pandora:

- Pandora free plan: http://www.pandora.com/account/register
- Pandora One free trial: http://www.pandora.com/one
  - Click the "Start Now" button
  - Sign in with your existing free account or register for a new account
  - Your free trial of Pandora One will last 24 hours

Spotify:

- Spotify free plan: https://www.spotify.com/us/
  - Click "Download Spotify"
  - Sign up with either Facebook or your e-mail address
  - Follow the installation instructions
- Spotify Premium free trial: https://www.spotify.com/us/premium/

- Click the "Start your free month" button
- Sign in with your existing free account or register for a new account
- Your free trial of Spotify will last one month

You may try the service on either desktop or mobile. If you have tried these services in the past, please use them over the next two days to refamiliarize yourself with their features.

We ask that you pay close attention to the different features of these services. In the second part of the survey, we will ask you how important these features are to you. You will only receive the incentive reward if you are able to answer these questions.

Part 2 Survey

Thank you for returning to take Part 2 of the streaming music survey.

We will now ask for your opinions about some new streaming music plans that could be offered by these services. Your answers will not be used to market any plans to you and no plans are being sold in this survey.

We offer you an incentive to participate in this survey. Here's how it works. You will be shown 15 sets of choices of streaming music plans and you will be asked to choose your preferred plan within each set. One of the choices in each set will be a free plan.

We will use a computer algorithm to understand your preferences for streaming music services. We will give you a gift that has a dollar value of $30 ***in total***. Based on your streaming music preferences in this survey, we will select a music streaming service among the ones currently available and give that to you, deducting its actual cost from the $30. Then we will give you the remaining amount as a VISA gift card.

For example, suppose that your preferred service costs $10 a month. Then, we will give you this service plus the remaining amount of $20 ($30 minus $10) as a VISA gift card. If this service is actually worth more to you than $10 a month, then you are better off with the service and the $20 VISA gift card than you would be with a $30 gift card. Of course, if the service is actually worth less to you than $10 a month, then you are worse off with the service and a $20 gift card than with a $30 gift card. Everyone will get at least $15 in VISA gift cards.

To guarantee that you get a streaming service that is worth more to you than its cost, try to weigh service features and costs carefully and accurately so that the choices you indicate tell us whether various features of streaming service plans are truly worth their cost.

In order to be eligible to receive the incentive, you must complete the survey within one hour of starting it. You will be prevented from moving through the questions too quickly and, if it appears that you are answering questions at random, you will not be eligible for the incentive.

Please press the **forward arrow to start the survey**

Next we will show you some descriptions of different music streaming plans. The following definitions may be helpful.

Playlist generation method

Playlists offered to a user can either be curated by music tastemakers (such as Beyoncé or Rolling Stone Magazine) or generated by a computer algorithm customized by the user's preferences or feedback (often provided by "like" or "dislike" votes).

Features available for streaming to a computer

Using desktop software or a web interface from a computer, users may be able to access playlists generated by the streaming service and/or play specific tracks "on demand." With "on demand" features, users can listen to particular tracks (songs) or an entire album on request and users can create their own playlists.

Ability to listen offline

Users can download and listen to a selection of the service's music when internet access is unavailable.

Features available for streaming to mobile devices

Users may be able to use the music streaming service on mobile devices, such as phones and tablets. The music streaming service may limit the features that are available on mobile devices. Users may be able to access playlists generated by the streaming service, pick the artist or album but hear tracks in a random order, and/or play specific tracks "on demand." With "on demand" features, users can listen to particular tracks (songs) or an entire album on request and users can create their own playlists.

Ability to skip songs

Users can skip tracks (songs) that they do not want to hear and continue to the next track.

Library size

The number of tracks (songs) available in the service's database

Advertising

Plans may be ad-free or may have advertising breaks in between tracks

Introduction screen (times 3 services)

Assume that [**Pandora/Spotify/one or more new services]** is currently offering the plans on the following screens. Please review these plans and answer the questions that follow.

If you currently have a plan with Pandora, all of your playlists, radio station, ratings and other settings will be preserved if you switch to a different plan.

Assume that any features that are not described are the same for all plans.

Conjoint cards (times 5 per service)

Comparison X

Assume that a streaming music provider is currently offering the 3 plans shown below.

Conjoint table example shown below for illustrative purposes

Features	Plan A	Plan B	Plan C
Available library size *definition*	1 million songs	10 million songs	20 million songs
Mobile device streaming *definition*	Not available	Playlists generated by the service Albums and artists chosen by you, but tracks are played in a random order	Playlists generated by the service Album, artist, and song selection on demand
Playlist Method: *definition*	Curated by music tastemakers	Curated by music tastemakers Generated by a computer algorithm customized by your preferences	Curated by music tastemakers Generated by a computer algorithm customized by your preferences
Price *definition*	Free	$6.99 per month	$12.99 per month
Advertising *definition*	1.5 to 3 minutes of ads per hour	No ads	No ads
Skip limits *definition*	Limit of 6 skips per hour	Limit of 6 skips per hour	Unlimited ability to skip tracks
Offline listening *definition*	Not available	Not available	Yes
On-demand track selection *definition*	Playlists generated by the service	Playlists generated by the service Album, artist, and song selection on demand	Playlists generated by the service Album, artist, and song selection on demand
	Plan A	**Plan B**	**Plan C**

Among the 3 plans shown, which plan do you most prefer?

- Plan A
- Plan B
- Plan C

During the past two days, how much (if at all) did you listen to music on Pandora?

- I listened to music on Pandora for more than one hour.
- I listened to music on Pandora for between 30 minutes and an hour.
- I listened to music on Pandora for less than 30 minutes.
- I didn't have time to listen to music on Pandora.
- I tried to listen to music on Pandora, but could not get it to work.
- I didn't try to listen to music on Pandora.

During the past two days, how much (if at all) did you listen to music on Spotify?

- I listened to music on Spotify for more than one hour.
- I listened to music on Spotify for between 30 minutes and an hour.

- I listened to music on Spotify for less than 30 minutes.
- I didn't have time to listen to music on Spotify.
- I tried to listen to music on Spotify, but could not get it to work.
- I didn't try to listen to music on Spotify.

We have asked you about many versions of paid music streaming services in this survey. If your favorite paid plan were to be offered, how likely would you be to sign up for this plan?

- Very likely
- Somewhat likely
- Neutral/Not sure
- Somewhat unlikely
- Very unlikely

We have asked you about many versions of free music streaming services in this survey. If your favorite free plan were to be offered, how likely would you be to sign up for this plan?

- Very likely
- Somewhat likely
- Neutral/Not sure
- Somewhat unlikely
- Very unlikely

APPENDIX C: ESTIMATION OF THE MODEL

A multinomial logit model implies that the probability of choice k from choice set *r* for individual *j* given the features x_{jri} and prices p_{jri} for all $i = 1, \ldots, K$, and individual-specific parameters γ_j and α_j has the form:[19]

$$(1) \qquad P(k|x_{jr},\gamma_j,\alpha_j) = \frac{\exp(\alpha_j(x_{jrk}\gamma_j - p_{jrk}))}{\sum_{i=1}^{K}\exp(\alpha_i(x_{jri}\gamma_j - p_{jri}))}.$$

Assume that the parameters (α_j,γ_j) are heterogeneous across respondents and are themselves random variables. The γ_j are the "part-worth" or willingness-to-pay parameter vectors, denominated in dollars. The α_j is a positive scaling parameter that can also be interpreted as the coefficient on price, signed so that the probability of choice k cannot rise when p_{jrk} rises. Assume the following population probability densities for these parameters:

- γ_j is distributed multivariate normal, with density $n(\gamma_j - \mu,\Omega)$
- α_j is distributed independently with a normal density that is truncated to be positive, $\alpha_j \sim h(\alpha \mid \rho,\sigma^2) \equiv A \cdot 1(\alpha > 0) n(\alpha - \rho,\sigma^2)$, where A is a constant defined so that the density integrates to one.

This model implies that the probability of choice k given features and prices is a mixed multinomial logit model:

$$(2) \qquad P(k|x_{jr},\mu,\Omega,\rho,\sigma^2) = A \int P(k|x_{jr},\gamma,\alpha) \cdot n(\gamma - \mu,\Omega) \cdot 1(\alpha > 0) n(\alpha - \rho,\sigma^2) d\gamma\, d\alpha.$$

To estimate this model, including the individualized parameters (α_j,γ_j), I use the Hierarchical Bayesian approach common in market research. I use the Stan and R programming languages to perform the estimation. Bayesian estimation requires establishing "priors" for the distributions in the model. I use relatively "diffuse" priors to permit the data to present itself as clearly as possible. Specifically, I assume the following hyperprior distributions:

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[19] For a discussion of this form, see Train, Kenneth and Weeks, Melvyn (2005) "Discrete Choice Models in Preference Space and Willingness-to-Pay Space" in Scarpa, Riccardo and Anna Alberini (eds.). *Applications of Simulation Methods*, Springer.

- Prior for the population mean of the attribute parameters $n(\mu, 100^2)$
- Prior for the population mean of the (negative) price parameter $n(\rho, 100^2)$
- Prior on the matrix of covariances among the attribute parameters for an individual respondent: $\Omega = \text{diag}(\tau)\Sigma\,\text{diag}(\tau)$
- Prior for the variance-covariance scaling factors: $\tau \sim \text{Uniform}[0, 100]$[20]
- Prior for the matrix of correlations: $\Sigma \sim \text{LKJ}(1)$[21]
- Prior for the variance of the scaling factor α: $\sigma \sim \text{Uniform}[0,100]$

For estimation, start with the MNL model (1) and treat (γ_j,α_j) as a random vector with the density $A \cdot n(\gamma - \mu, \Omega) \cdot 1(\alpha > 0) n(\alpha - \rho, \sigma^2)$ so that the joint density of this vector and observations $(x_{jr},d_{jr}) = (x_{jr1},\ldots,x_{jrK};d_{jr1},\ldots,d_{jrK})$, where d_{jrk} is one if k is respondent j's stated choice and zero otherwise, is

(3) $L(<\gamma_j, \alpha_j>; \mu,\Omega,\rho,\sigma^2|d,x)$

$$= \prod_{j=1}^{J} \prod_{r=1}^{R} \prod_{k=1}^{K} P\left(k\middle|x_{jr}, \gamma_j, \lambda_j\right)^{d_{jrk}} n\left(\gamma_j - \mu, \Omega\right) \cdot A \cdot 1(\alpha > 0) \cdot n\left(\alpha_j - \rho, \sigma^2\right).$$

Introduce a (diffuse) hyperprior distribution $f(\mu,\Omega,\rho,\sigma)$ on the parameters μ,Ω,ρ,σ, as described above, and form the posterior density

(4) $B \cdot L(<\gamma_j,\lambda_j>,\mu,\Omega,\rho,\sigma^2|d,x) f(\mu, B, \Omega, \rho, \sigma^2)$,

where B is a scale factor that makes the integral of this density over μ,B,Ω,σ equal to one.

The mean of this density with respect to (γ_j,α_j) gives the Bayes estimator of the individualized parameters of respondent *j* and the mean with respect to μ,Ω,ρ,σ gives the Bayes estimators of the mixed MNL parameters. With diffuse priors, the later estimates will be nearly the same as their classical maximum likelihood estimates and any difference is arguably not an improvement as long as there is no real information going into the priors.

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[20] The highest price listed in the conjoint study is $13, which establishes a limit on how variable willingness to pay measures can be.

[21] This is the distribution recommended by the Stan development team, which consists of many experts in Bayesian estimation and computation. It is based upon Lewandowski, Daniel, Dorota. Kurowicka, and Harry Joe. (2009) "Generating Random Correlation Matrices Based on Vines and Extended Onion Method." *Journal of Multivariate Analysis* 100: 1989-2001. See also Stan Development Team (2014) *Stan Modeling Language Users Guide and Reference Manual, Version 2.4.*

I also estimated versions of the model in "utility space" rather than "WTP space" as defined above using conventional logit and mixed logit models. For the mixed logit models, I first estimated a model that does not include correlations between the coefficients and a second that does include these features. The former is most closely related to the standard logit model while the latter is similar to the hierarchical Bayesian approach that I use for my preferred models. These coefficient estimates are shown in Table 6 and the corresponding willingness-to-pay values are shown in Table 7 for the unweighted sample of survey respondents. To perform this conversion, each attribute coefficient is divided by the price coefficient and multiplied by negative one.[22] The standard errors are approximated using the Delta method. For the on demand features that I consider, these models provide similar estimates to the preferred hierarchical Bayesian approach.

[22] See, for example, Train, Kenneth E. 2009. *Discrete Choice Methods with Simulation*. 2nd ed. Cambridge University Press.

Table 6: Estimated Coefficients

	Logit	Mixed logit without correlations	Mixed logit with correlations
Price	-0.221 (0.006)	-0.491 (0.011)	-0.557 (0.012)
No advertising	0.476 (0.051)	0.960 (0.069)	1.016 (0.076)
Current plan	0.446 (0.050)	0.548 (0.075)	0.671 (0.084)
Catalog from 1M to 10M	0.210 (0.054)	0.452 (0.084)	0.492 (0.097)
Catalog from 1M to 20M	0.301 (0.065)	0.649 (0.100)	0.630 (0.119)
Catalog from 1M to 20M+	0.277 (0.060)	0.739 (0.092)	0.685 (0.112)
Playlist from taste markers to algorithm	0.155 (0.029)	0.363 (0.043)	0.384 (0.050)
Playlists for both alg. and tastemakers	0.099 (0.036)	0.224 (0.051)	0.266 (0.062)
Free plan	0.413 (0.052)	-0.191 (0.074)	-0.103 (0.085)
Addition of computer on demand features	0.175 (0.037)	0.333 (0.059)	0.348 (0.065)
Addition of mobile service	0.275 (0.038)	0.536 (0.058)	0.489 (0.066)
Addition of mobile service with randomization	0.338 (0.052)	0.783 (0.076)	0.746 (0.088)
Addition of mobile service with on demand features	0.470 (0.053)	0.858 (0.079)	0.855 (0.090)
Offline listening	0.343 (0.034)	0.636 (0.048)	0.703 (0.058)
Unlimited skips	0.340 (0.034)	0.653 (0.048)	0.741 (0.058)

Table 7: Estimated Willingness-to-Pay Values (dollars)

	Logit	Mixed logit without correlations	Mixed logit with correlations
No advertising	2.16 (0.21)	1.96 (0.12)	1.83 (0.12)
Current plan	2.02 (0.24)	1.12 (0.16)	1.21 (0.15)
Catalog from 1M to 10M	0.95 (0.25)	0.92 (0.17)	0.88 (0.17)
Catalog from 1M to 20M	1.36 (0.30)	1.32 (0.20)	1.13 (0.21)
Catalog from 1M to 20M+	1.26 (0.27)	1.51 (0.18)	1.23 (0.20)
Playlist from taste markers to algorithm	0.70 (0.13)	0.74 (0.09)	0.69 (0.09)
Playlists for both alg. and tastemakers	0.45 (0.16)	0.46 (0.10)	0.48 (0.11)
Free plan	1.87 (0.24)	-0.39 (0.15)	-0.19 (0.15)
Addition of computer on demand features	0.79 (0.17)	0.68 (0.12)	0.63 (0.12)
Addition of mobile service	1.25 (0.17)	1.09 (0.12)	0.88 (0.12)
Addition of mobile service with randomization	1.53 (0.23)	1.60 (0.15)	1.34 (0.16)
Addition of mobile service with on demand features	2.13 (0.24)	1.75 (0.15)	1.54 (0.16)
Offline listening	1.55 (0.15)	1.30 (0.09)	1.26 (0.10)
Unlimited skips	1.54 (0.15)	1.33 (0.09)	1.33 (0.10)
Total on demand (computer & mobile)	1.68 (0.22)	1.33 (0.15)	1.28 (0.15)

APPENDIX D: DOCUMENTS RELIED UPON

A. Academic Articles and Books

1. Allenby, Greg M. and Peter E. Rossi. (1999) "Marketing Models of Consumer Heterogeneity" *Journal of Econometrics.* 89: 57-78.
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