# AN INVESTIGATION OF TWO BEHAVIOURAL ECONOMIC APPROACHES TO EVALUATING REINFORCER VALUE

A thesis

submitted in partial fulfillment

of the requirements for the degree

of

**Master of Applied Psychology (Behaviour Analysis)**

at

**The University of Waikato**

by

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2010

# ABSTRACT

This study compares two approaches for comparing the value of two different reinforcers. The own-price demand method compares the changes in consumption of the reinforcers resulting from increases in the number of responses required to gain access to the reinforcers. Experiment 1 assessed own-price demand for two reinforcers. Six hens responded under increasing fixed-ratio schedules when either wheat or puffed wheat was delivered for key-pecking. The quantity consumed (measured as either numbers of reinforcers obtained or weight of food consumed) was plotted against the FR size on log-log coordinates to give the own-price demand functions. Three functions were fitted to the data and all described the data well. The parameter values from Hursh's (1988) and Hursh and Winger's (1995) equations were generally consistent with wheat being the preferred reinforcer data when derived from the weight of food consumed. Those derived from number of reinforcers were inconsistent. The essential value, α, from the equation proposed by Hursh and Silberberg (2008), when k was fixed at 6.5, were smaller when weight was used and were weight was used and were larger when number of reinforcers was used as the consumption measures and so suggested the essential value changed. These data show that the outcome is affected by how the consumption is measured. It seems that that the above models were similar. The cross-price demand method examines the divergence of the cross-point of two demand functions. In Experiment 2 assessed the cross-point using the same six hens responding under concurrent fixed-ratio fixed-ratio schedules over nine pairs of schedules: FR1/FR256, FR8/FR32, FR128/FR2, FR4/FR64, FR256/FR1, FR32/FR8, FR2/FR128, FR16/FR16 and FR64/FR4. In Condition 1 both schedules gave access to wheat, in Condition 2 both gave puffed wheat, and in Condition 3 one gave wheat and the other puffed wheat. The numbers of each reinforcer obtained and weight of each food consumed were plotted as functions of the left fixed-ratio values to give the cross-price demand functions. When the two reinforcers were identical the cross point tended to be around the ratio used for the equal schedules session (16) with both number of reinforcers and weight of food.. When the two reinforcers differed the cross point for most hens moved to higher ratio when weight of food consumed was used, suggesting that wheat was more valued than puffed wheat for these hens. This was not so for number of reinforcers. Both experiments show that how the consumption was assessed affected the conclusions from that method. Overall the cross-price demand analysis appeared to be the easier to interpret.

## ACKNOWLEDGEMENTS

I would like to thank my supervisors, Professor Mary Foster and Dr Lewis Bizo for their encouragement, guidance and support from the initial to the final stage of this thesis. I am grateful for their patience and time invested in getting the best from me.

I would also like to acknowledge Ms Jennifer Chandler for her support in designing the programmes and help in setting up the experiments.
Lastly, I would like to thank the staff and all the students at the laboratory for running the experiment and the all of those who supported me in any respect during the completing of the project. Without all of your supports the completion of this project would be impossible.

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The term demand refers to the change of in quantity of a commodity consumed as a function of the change in price of the commodity (Green & Freed, 1998). Typically demand functions show the decreases in consumption of a commodity as the price increase (Hursh, 1980).

The term “price” used in the literature of behavioural economics does not refer to the money that an individual would use to pay for a commodity. Price is the amount of work required from an individual in exchange for access to a set amount of the commodity. To examine consumption changes researchers vary the amount of work required and studies changes in amount in consumption. In behavioural economics with animals the concept of price is translated to the amount of effort an animal has to use to obtain the commodity. If an animal will put some effort into obtaining a commodity or an activity, this commodity or activity is regarded as a “reinforcer” (Lea, 1978, p. 443).

Fixed Ratio (FR) schedules have been used as the analogue of price of the reinforcer (Lea, 1978). An FR schedule defines the exact number of responses that are required before a reinforcer is delivered. For example, an FR-2 schedule would require two responses from an individual before a reinforcer is delivered. Some examples of the types of responses used to vary price in previous studies include changing the number of lever pulls for monkeys (Foltin, 1991), the number of pushes on the response plate from pigs (Matthews & Ladewig, 1994), the number of pecks by hens on response key (Foster, Blackman & Temple, 1997; Flevill, 2002) and the number of lever presses for rats (Holm, Ritz & Ladewig, 2007).

Dawkins (1988) suggested this method might provide a useful way of measuring values. Since then animal researchers have studied the effects of changing the values of FR schedule or the consumption of a range of commodities. For example, Hursh and Natelson (1981) studied the effect of changing FR schedules on rats' demand for electrical brain stimulation (EBS) and food pellets. The rats were exposed to a series of FR schedules and were reinforced with access to either EBS or food for completing the FR requirement with lever presses. The result showed that rats' consumption of the reinforcers decreased as the FR value increased

**The Elasticity of Demand**

The degree to which the consumption changes with the price increases is known as the elasticity of the demand function (Hursh, 1980). When the relation between consumption and effort are plotted in log-log (logarithms) co-ordinates, the slope of the function is gives a measure of the elasticity of demand. Hursh (1980) illustrated the way consumption and response rate can change with changes in price (see Figure 1). The left panel shows possible changes in consumption (Q) as price P (e.g. FR size) is increased (or the demand function). The middle panel shows how response rate (R) or output would need to change to produce these demand functions. The right panel shows the demand functions on log-log co-ordinates (*log Q* vs. *log P*). These last functions are the usual way these data are represented.

The elasticity coefficient (EC) is the measure of elasticity shown in Figure 1. Hursh (1980) discussed four types of elasticity of demand, inelastic demand, unit elasticity, elastic demand and mixed elasticity.

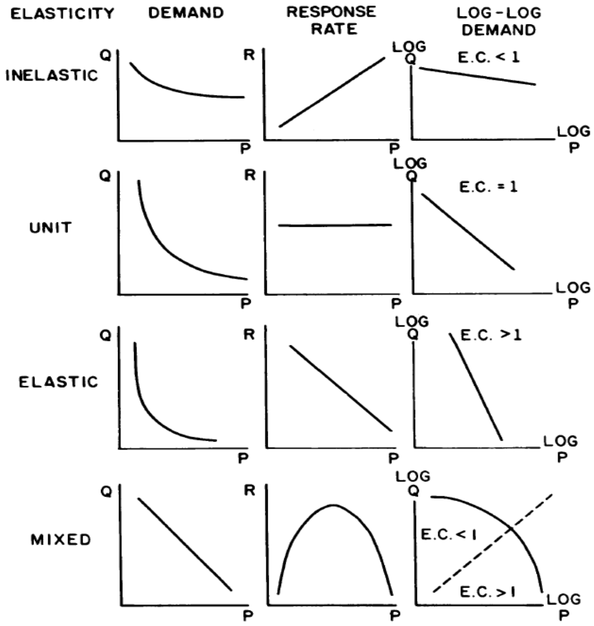


*Figure 1.* Four types of elasticity.

The four types of elasticity of demand, response rates and the elasticity coefficients plotted on log-log co-ordinates. Reproduced from "Economic concepts for the analysis of behavior", by Hursh, 1980, Journal of the Experimental Analysis of Behavior, 34, p. 227

First, an inelastic demand function is one with shallow slope and has an EC value of less than one (<1) as illustrated as the top right panel of Figure 1. For reinforcers with inelastic demand the individual increases the response rate as the requirement of an FR schedule is increased (top middle panel) and consumption may decrease but only gradually as price increase. An inelastic demand curve suggests the reinforcer is important or highly valued. Dawkins (1988) suggested it is possible that in inelastic demand curves indicate a need.

Second, unit elasticity is found when the function has a slope with an EC value of one (=1) as illustrated as the second right panel of Figure 1. Unit elasticity of demand reflects no change in the effort expended to obtain the reinforcer with the change in FR value. The individual continues to respond at the same rate but gets less of the reinforcer as the FR value gets larger.

Third, an elastic demand function is one with steep slope and an EC value of greater than one (>1) as shown on the third right panel in Figure 1. An elastic demand function reflects a big decrease in quantity consumed with small increase of FR values. For reinforcers with elastic demand the individual decreases response rates as the requirement of the FR schedule is increased (third middle panel) and so consumption decreases steeply as price increases. An elastic demand suggests that the reinforcer is unimportant or not valued. Dawkins (1988) suggested an elastic demand could indicate a luxury.

Fourth, mixed elasticity is characterized by a downward curve with part of the slope with EC equal to less than one (<1) and part of the slope with EC value greater than one (>1). The lowest right panel of Figure 1 showed a function with mixed elasticity of demand. For reinforcers with mixed elasticity demand the function is normally flat or inelastic at small FR values but as the FR value gets bigger the quantity consumed decreases and so the function is deemed elastic. Hursh (1980) pointed out that mixed elasticity is a result of bitonic response rate function, which is commonly found in behaviour economics research. Dawkins (1988) suggested the relative values of reinforcers can be compared by examining the elasticity. There is quite a body of research that used demand functions to compare values of different reinforcers. For example, Hursh and Natelson (1981) compared the elasticity of foods and electrical brain stimulation with rats, Foltin (1991) compared baboon's demand for food pellets and Matthews and Ladewig (1994) compared the elasticity of three different reinforcers with pigs.

**Own-Price Demand**

One method used for comparison is to generate own-price demand functions. These functions relate the change in quantity consumed and the change in the FR schedules (price) for a reinforcer when no other reinforcers are available (Green & Freed, 1998). The procedure used in the study of own-price demand usually requires the subjects to work for the reinforcer across a range of FR values and the number of reinforcers obtained at each of the FR value is recorded as the amount consumed. When two or more reinforcers are to be compared, the subjects are first exposed to one reinforcer across a series of FR schedules, and then the second reinforcer is presented over the same series of FR schedules. The consumption at each of the FR values is plotted as a function of the FR (price) on log-log co-ordinates (as in Figure 1). The elasticities of these demand functions are used to compare the values of the different reinforcers.

Matthews and Ladewig (1994) used own-price demand to compare the value of three different reinforcers with pigs. Eight pigs were trained to push a round plate attached to the cage with their snouts to gain access to each of the three different reinforcers: 27 g of food pellets, 15 s of social contact with another pig and to open-door 15 s.  The experimenters varied the FR schedule as the price change for the reinforcers. The FR values were FR 1, FR 2, FR 5, FR 10, FR 15, FR 20 and FR 30. The numbers of reinforcers obtained at each of the FR for each of the reinforcers were recorded and plotted as the demand functions. Linear functions were fitted to the data and the slopes of the functions were compared. The results were the slope of the demand for food was shallowest, followed by the slope of the demand for social contact and the slope of the demand for the open-door activity was the steepest. Based on the results the authors concluded that the food was the most valued reinforcer then the social contact and then the open-door activity. Thus this study used Dawkins (1988) proposal of comparing the elasticity of demand to assess the relative values of reinforcers.

Matthews and Ladewig (1994) pointed out that the demand for the open-door activity showed that it was almost equally valued as social contact. They suggested that the reason for the pigs worked for this activity was they were kept in a restrictive environment prior to the experiment. Hence, they suggest this shows that the slopes of demand functions are sensitive to such variables.

A factor that may influence subjects' consumption of the reinforcers in an experimental setting is the type of economy. Hursh (1980) suggested two types of economies, either the closed economy or the open economy are in effect in any experimental environment. A closed economy is a situation where the reinforcer is accessible to the subject during the experimental session for example the monkey's daily food intake was only given within the experimental session, no extra food given after session. While the open economy refer to situation where food are given to the subjects after the experimental session to maintain the subject the daily food requirement. Hursh (1980) reported that monkey's demand for food varied in closed economy and in open economy. When food was given to the subjects only within the experiment (i.e., a closed economy) their response rate increased steeply as the FR values increased thus generating an inelastic demand. When extra food was available after the session (i.e., an open economy) the response rate increased gradually as the FR values increased, generating an elastic demand Foster, Blackman and Temple (1997) pointed out that frequently open and closed economies co-vary with the session duration. That is, in order to gain all food in a session, the session needs to be long. While in order to be able to provide food outside of the session requires short session when the FR is small or requires that the number of feed obtain in a session be limited in some way.

The consumption changes seen when assessing demand are a product of the way the animals' behaviour changes as the FR changes. There are three measures of behaviour typically used when studying FR schedules. They are the overall response rate (ORR), the running response rate (RRR) and the post-reinforcement or pre-ratio pause (PRP). The ORR is calculated by dividing the total number of responses per session by the total response time. Typically when the FR is varied over the wide range of values the patterns of responding the ORR is an increase as the FR increases then a peak and decrease as the FR values increase further (Foster, Blackman, & Temple, 1997). The RRR is calculated by dividing the total number of responses per session by the time within the experiment session minus the PRP time (also called response rate). The patterns of responding over a range of FR values for RRR may either be an increase at small FRs and decrease as the FR values increase or increase as the FR value increase and level off at large FR value (Crossman, Bonem, & Phelps, 1987).The PRP is the period of non-responding after the reinforcer delivery up to the first response of the next FR schedule (Mazur & Hyslop, 1982). It is calculated by dividing the total duration of the PRP in the session by the number of reinforcers obtained at each FR values. Sometimes the way session time is recorded depends on the study. The experimental session includes the time food was available. Most studies with hens exclude the magazine operating time from the session time. The PRP for small FR values are most often short and they get longer for larger FR values. Felton and Lyon (1966) found this with pigeons exposed to FR schedules.

When ORR increased then decreased this gives a mixed elasticity demand function as shown in the bottom sets of graphs in Figure 1. Sometimes there are not enough data points to describe the curvy linear function fully. In this case, the data can often be reasonably well described by a linear function. As in the top three sets of graphs in Figure 1. Sometimes, the curvature in the data is large enough that a curve line better fits the data.

**The Non-Linear Demand Equation**

When the relation between consumption and price is curvilinear a non-linear demand function is needed. An equation that describes a non-linear function proposed by Hursh, Raslear, Shurtleff, Bauman and Simmons (1988) is:

$$\text{Log}\ (Q) = \log\ (L) + b\ [\log\ (\text{P})] - a\ (\text{P}) \qquad (1)$$

where $Q$ is the consumption at the FR value and $P$ is the price (FR value). The fitted parameters are $L$, the initial consumption at the lowest price or at FR 1, $b$, the initial slope of the demand function, and $a$, the rate of change of slope of the demand function.

For example the study by Foltin (1991) provides an illustration of demand analysis for food with a non-linear function. Foltin (1991) used baboons and examined the baboons' demand for banana flavoured pellets. The baboons were trained to pull a lever attached to the cage for food pellets for a session of 22 hours over series of ascending FR and descending FR schedules. The FR schedules varied in the study were FR 2, FR 4, FR 8, FR 16, FR 32, FR 64, FR 96 and FR 128. The weight of the food pellets consumed at various FR values was plotted as a function of FR value and Equation 1 was fitted to the data. The parameter values, $L$, $a$, and $b$ were examined. The finding was that baboons' demand was inelastic at most FR values the baboons would response faster as the FR increases until the FR value was so large the baboons could not complete the required number of responses in the session. The baboon's consumption of the food pellets dropped at this point (FR value). Foltin concluded that baboon's demand for banana flavoured pellets was well described by Equation 1. However, Foltin highlighted the baboon's response rates increase to quite high rates before dropping as FR increased further and argued that the rates of the rise to this maximum response rate might be a value for comparison and should be included as a parameter for demand analysis. This value has been subsequently termed $P_{max}$ (Hursh and Winger, 1995).

## Maximum Price: $P_{max}$

The FR value correspond to the maximal response output is $P_{max}$ or the price at maximal output (Hursh & Winger, 1995). This is not only the highest point in the ORR function but also the point at which the slope of the demand curve changes from inelastic to elastic or EC equals one. The equation for $P_{max}$ (Hursh & Winger, 1995) is:

$$P_{max} = (1 + b) / a \qquad (2)$$

When $a$ and $b$ are as in Equation 1 $P_{max}$ has been suggested as a parameter that can be examined when demand functions are uses to measure the value of reinforcer. It is suggested as an indicator of how much effort the subject would expend to gain the reinforcer. If the value of $P_{max}$ for one reinforcer is higher than for another, then the first reinforcer is suggested to be more valuable. $P_{max}$ has been used in studies to compare demand for different commodities such as heroine and cigarettes (Jacobs & Bickel, 1999).

## The Normalised Demand Equation

Winger (1993) examined monkeys' demand for drugs on three different doses of two drugs, Cocaine and Methohexital. The drugs were dispensed when the monkeys successfully completed the FR requirement on a the response lever. The amount consumed at each FR value was plotted as a demand function and

Equation 1 was fitted to the data. . Winger (1993) compared the parameter values *L*, *a* and *b* of each function and found the monkeys' demand for three doses of Methohexital was well represented by a single demand function. However, the demand for different doses of Cocaine differed, for higher doses of Cocaine the consumption was greater at larger FR value but for smaller doses the consumption was lesser at small FR. This result suggested that Cocaine at different doses could be represented as different reinforcers. This study illustrated the inadequacy of Equation 1 in describing the demand of reinforcers with qualitative differences in size, density, dosage and weight.

To solve the problem associated with demand function that shows different initial consumption due to qualitative differences the Normalised Demand Equation was proposed by Hursh and Winger (1995). This equation is:

$$\ln (Q) = \text{In } (100) + b\,[\text{In } (P)] - a\,(P) \qquad (3)$$

where $Q$ is the quantity consumed, $P$ is the FR value, "$b$" is the initial slope and "$a$" is the rate of change of slope. This normalised equation transformed the initial level of consumption ($L$) with a base value of 100 so that all initial consumption began from a reference point of 100.

The normalized process changes (rescales) the consumption value and so changes the initial consumption (log C) and the rate of change on the slope of the function changes the value of $P_{max}$. The authors claimed that this normalized demand equation would simplify the process of comparing reinforcers with qualitatively difference. To test the model they fitted Equation 3 to data sets obtained from two previous studies where monkeys were given various drugs in different doses; Cocaine and Methohexital (Winger, 1993), and Alfentanil and Nalbuphine (Winger, Woods & Hursh, 1996) with different initial consumption values. The parameter estimates from the fitted functions for Cocaine, Methohexital, Alfentanil and Nalbuphine were examined and compared. The result showed that Alfentanil was most valued with the highest $P_{max}$ value. Based on the findings Hursh and Winger (1995) proposed Equation 3 would be suitable for demand analysis with reinforcers with qualitative differences and the $P_{max}$ was a reliable indicator of relative reinforcer value.

**The Exponential Demand Equation**

In the pursuit of further simplifying the process of using demand analysis to assess reinforcer efficacy, Hursh and Silberberg (2008) introduced the Exponential Demand Equation, that uses a single parameter *Alpha (*$\alpha$) or the "Essential Value" as a scaling factor for the value of reinforcer. The value $\alpha$ is inversely related to the value of a reinforcer (i.e. a small $\alpha$ value represents high reinforcer value and a large $\alpha$ value represents low reinforcer value). The Exponential Demand Equation is:

$$\log Q = \log Q_0 + k\,( e^{-\alpha \cdot Q_0 \cdot C} - 1 ) \qquad (4)$$

where Q is the quantity consumed, $Q_0$ is the quantity consumed at the lowest price, *C* is the cost or the FR value, *k* is the range of consumption and *k* needs to keep at the same value when for comparing data sets. Hursh and Silberberg (2008) fitted Equation 4 to data from rats working for food pellets at different FRs from previous studies (Hursh et al., 1988) to test its reliability as a measure of reinforcer value. The results showed that the $\alpha$ values for two different sizes reinforcers of some food were the same, indicating the food was of similar values. Equation 4 was then fitted to data from various studies including monkeys' demand for food (Hursh, 1991), pigeons' demand for grain (Timberlake, 1984) and the studies reviewed by Lea (1978), to test its robustness. The results were similar, smaller $\alpha$ value for more valued reinforcers. The authors concluded that

Equation 4 is reliable and α is a good measure of the value of reinforces with qualitative differences.

Christensen, Silberberg, Hursh, Hansberry and Riley (2008) tested the reliability of α by fitting Equation 4 to the data of rats that pressed levers for either two 45-mg food pellets or for 1 mg/kg of cocaine infusions. In their Experiment 1, both reinforcers were presented in a session with either food pellets or cocaine presented and signaled by a different coloured light. The FR schedule was varied and the consumption at each FR was analysed as a demand function. In Experiment 2 only cocaine was presented across the same FR schedules. In Experiment 3 only food pellets were presented to the rats. Equation 4 was fitted to the data from the three experiments and the parameter values of α for food and for cocaine were compared. The results showed α for cocaine was lower than for food. Based on the finding Christensen et al. (2008) concluded that Equation 4 described all data well and the value α clearly showed that cocaine was more valued by the rats.

In studying hens' demand for three reinforcers, Foster, Sumpter, Temple, Flevill and Poling (2009) first assessed the hens' performance for wheat, puffed wheat and honey puffed wheat. The order of preferences established was wheat (most preferred) then honey puffed wheat and puffed wheat. The hens were then exposed to the reinforcers in a demand assessment. The data used were the number of reinforcers received at each FR values for each of the three reinforcers. These were plotted as demand function and fitted with each of the three demand equations: Equations 1, 3, and 4, using nonlinear regression for analysis. The authors compared the three fitted functions. Foster et al. (2009) found that the parameter values obtained from each of the fitted functions did not reflect value of the reinforcers in terms of the hens' preference. For example, with Equation 1 the value of *Ln L* for wheat was the lowest but the $P_{max}$ for wheat was highest. With Equation 3 the value of $P_{max}$ for puffed wheat was highest because of the normalization process. The author pointed out that with Equation 4 the values *Ln Qo* and $\alpha$ change when the value of *k* changes. There were significant differences in the $\alpha$ values when different *k* values were selected. For these data $\alpha$ was lowest for puffed wheat than for other foods at $k$=8, indicating puffed wheat (the least preferred food) as most valued based on Hursh and Silberberg's argument that smallest $\alpha$ indicates the most valued reinforcer. Puffed wheat also gave the highest $P_{max}$ values, which should not be the case if it was of lesser value. Thus, further work is needed to clarify the essential values proposed by Hursh and Silberberg (2008) and on the appropriate measure of consumption. Flevill (2002) suggested that one problem with the data was that consumption was measured using the number of reinforcers and that it maybe the weight of food eaten could be a more appropriate measure.

**Cross-Price Demand**

Another procedure that has been used to compare two reinforcers is termed cross-price demand. In "cross-price demand" (Green & Freed, 1998) the effect of the price changing for one reinforcer on the changes in consumption of another reinforcer when both are simultaneously available is examined. . These studies typically involve two commodities each available on a different FR schedule, for example, an FR 8 schedule on the left and FR 4 schedule on the right. A reinforcer for the left key is delivered when the subject completes eight responses on the left and a reinforcer for the right key is delivered when there have been four responses on the right key. Such schedules are termed "Concurrent Schedules of reinforcement" (or Conc FR FR schedules).

Green and Freed (1993) outline three possible effects one reinforcer may have on the other. First, one may be substitutable for the other. This is seen when the demand for one reinforcer is more elastic when another reinforcer is present. In this case the reinforcers are regarded as substitutable and the subject would switch to the reinforcer with the lower price when the cost of the other is increased. Substitutable reinforcers have similar functions. Madden, Smettheils, Ewan and Hursh (2007) reported that water and food are somewhat substitutable from data obtained from their study with rats. They reported that when the FR values for food increased, the rats would allocate more responses to getting water and that the consumption of water increased. Second, they suggested that one reinforcer may be complementary to the other. This is seen as the consumption of the two reinforcers changing in the same direction when the price of one reinforcer changes. Such reinforcers are regarded as complementary and the subject would consume both reinforcers when presented. Third, one reinforcer may not affect the other (or independent of the other). This is seen when any changes in the consumption of one reinforcer do not affect consumption of the other.

There are several ways researchers vary the Conc FR-FR schedules. For example, Blackman (1990), Sorensen, Ladewig, Matthews, Ersboll and Lawson (2001), Sorensen, Ladewig, Ersboll and Matthews (2004), Holm, Ritz and Ladewig (2007) and Holm, Jensen, Pedersen and Ladewig (2008) varied the FR schedules systematically across a range of values from small to large for one reinforcer and kept the FR value constant for the other reinforcer. Holm et al. (2007) refer to this method of varying the Conc FR FR schedules as the one alternating lever procedure. They used rats and examined their demand for

distilled water and quinine water. The two reinforcers were presented to the rats and the left respond lever was fixed and the other lever was varied.
Sorensen et al. (2004) used a similar procedure but kept the fixed FR on the right lever and vary the FR on the left then kept the left FR constant and vary the right. Another method of presenting the Conc FR FR schedules is to vary the FR schedules for both reinforcers in systematic way. This is referred as the two alternating levers procedures (Holm et al., 2007).

Blackman (1990) examined hens' demand for wheat when other food was also available under a FR schedules. Six hens were given several pairs of food: wheat, commercial food pellets for hens, bran and crushed maize under Conc FR FR schedules. The one-alternating lever procedure was used, one of the schedules was varied from FR 5, FR 10, FR 20, FR 40, FR 60 to FR 80 and the other was fixed at FR 20. The consumption of the various reinforcers at different FR was examined to see if the foods were substitutable, independent or complementary. Blackman (1990) found that when wheat was presented on both sides the proportion of reinforcer received was 1.0 at FR 5 vs. FR 20 and the proportion of reinforcer received at FR 80 vs. FR 20 was 0.0 (i.e., the hens responded exclusively on the side with the lower FR). The two reinforcers were identical and so had similar functions. The overall finding showed that hens responded for the reinforcer that required less effort and it was concluded that the reinforcers presented were all substitutable for wheat.

Since then such cross-price demand assessments have been used to assess various commodities with various species. For example, Sørensen, et al.'s (2001) rats worked for distilled water, acidified water and saccharine water across a series of Conc FR FR schedules. The one alternating lever procedure was used to vary the Conc FR FR schedules across four test conditions comparing distilled water vs. distilled water (Condition 1), distilled water vs. saccharine water (Condition 2), acidified water vs. distilled water (Condition 3) and acidified water vs. saccharine water (Condition 4). The FR value and the amount consumed at each value were used in their analysis. They found their data was well fitted by a linear equation on non log axis. This linear equation used to plot the function was:

$$Y = mX + i \qquad (5)$$

where Y is the amount consumed at the FR value, X is the FR value (price), *m* is the slope of the function and *i* is the intercept on the y-axis or predicted amount consumed at lowest FR value. This gives two functions for each food. Sørensen et al. (2001) then found the points at which the two functions intercepts examined the substitutability of the reinforcer. They refers to this point as the cross-point (CP).

Sørensen et al. (2001) and Holmes et al (2007) agree that the CP is determined by the relative attractiveness of the reinforcers. The more one reinforcer is preferred to the other the larger the diversion of the CP relative to the midpoint.

The equation for the cross-point is:

$$CP_x = (i_1 - i_2) / (m_1 - m_2) \qquad (6)$$

where *m* is the slope and *i* is the intercept and the position of the CP along the axis indicating the price (FR value) were examined. Sørensen et al. (2001) compared CPs from the functions of all the conditions and found that the position of CPs for Condition 1 was FR 67, Condition 2 was FR 69, Condition 3 was FR 84 and Condition 4 was FR 88. In this case Condition 1 set the baseline for CP comparison and the CPs for Condition 3 and 4 was larger than FR 67 suggesting that rats would work for distilled water to a larger FR values (FR 84 or FR 88) before switching to the less preferred water. The positions the CPs for Condition 1 and Condition 2 were quite similar suggesting that saccharine and distilled water were substitutable. Based on the findings they concluded that the cross-point of the two demand functions was a sensitive measure of the relative value of reinforcer.

While some data were well described by linear demand function, other studies have found curvy linear function. For example, a study by Holm et al. (2008) on food in pigs' rooting materials with linear demand functions fitting the data was inappropriate and the result was unclear. To overcome this, Holmes et al, (2007) fitted curvilinear equation taken from Nielsen, Ritz and Streibig (2004) to the data of rats' consumption of various types of water at a range of FR values. This function is sigmoidal. The equivalent of the equation is.

$$Y = C + [\,(D - C) / (1 + \exp(g(\log(p) - \log(I_{50}))))] \qquad (7)$$

where Y is the number of reinforcers obtained, $p$ is the FR values or price. $D$ and $C$ are the lower and the upper limits of Y of the consumption. $I_{50}$ is the FR value giving 50% of reinforcers between $D$ and $C$, and $g$ is the slope of the non-linear curve at the $I_{50}$ point (Holm et al., 2007, p.139).

Holm et al. (2007) trained rats to press levers for distilled water and quinine water. For one condition (D-A) distilled water was available on both schedules and the two alternating levers procedure was used. The price of each of the reinforcers was varied and the order of presentation of the left FR and right FR schedules were: FR10/FR50, FR20/FR40, FR30/FR30, FR40/FR20 and FR50/FR10. The distilled water was still available on both schedules but the one-alternating lever procedure was used with one of the FR schedule fixed at FR30 and varied the other across FR50 to FR10 as the (D-NA) second condition. Then quinine water was presented on the left with the two-alternating levers procedure (Q-NA) and one-alternating lever procedure (Q-A) The number of reinforcers obtained on both levers for four test conditions were plotted as cross-price demand curves. Equation 7 was fitted to the non-log data. Sigmoid shaped functions were obtained and the cross-point relative to the right lever FR was estimated. The positions of the CP estimated values for distilled water were similar for D-A and D-NA (around 32) but for the quinine water the CP were all outside the range of the FR values (i.e.,. greater than FR 50). The authors concluded that rats preferred distilled water because the values of CP were nearer to the middle FR value (FR 30) where the CP for quinine water were greater than this. They suggested that the two-alternating levers procedures is an easier method for generating CP and the sigmoidal function better described their data then the linear function, and hence producing a reliable CP.

Two behavioural economic approaches; the own-price demand and cross-price demand , are used in various areas to determine the relative value of reinforcers through examining the relation of the change in consumption of the reinforcers at each FR value (price) as the price changes. The approaches and data analysis are somewhat similar but to what extend are they related or not is yet to be explored.

**The Objectives of the Study**

The objectives of the study were to compare two approaches, the own-price demand and cross-price demand with hens for measuring the relative values of reinforcer. The first part of this study replicated Foster et al. (2009)'s study with two types of foods (wheat and puffed wheat). In addition to the number of reinforcer, weight of food was also recorded as the measure of consumption. The data will then analysed and compared across three demand models for the reinforcer values. The essential value (alpha) as the scaling factor for reinforcer value was also examined. The second part of the study explored the two-alternating levers procedure of varying the Con FR FR schedules with the same two foods. The CP obtained with both the linear equation (Sorensen et al., 2001) and the sigmoidal equations (Holmes et al., 2007) were compared.

This study did not access hen's performance for wheat and puffed-wheat but assumed Flevill (2001) finding, the wheat would be preferred to puffed wheat.

The hypothesis of the study is that the two approaches of evaluating the reinforcers should show that wheat is valued more highly than puffed wheat by the hens.

## EXPERIMENT 1

### Own-Price Demand

Experiment 1 replicates the general methodology of the demand study by Flevill (2002) who compared hens' demand for three types of reinforcers; wheat (W), puffed wheat (PW) and honey puffed wheat (HPW) across, a series of FR schedules from FR 1 through a maximum of FR 1024. Flevill fitted Equation 1 to her data and compared the parameter estimates and the values of $P_{max}$ found for the three foods. Flevill found that hens obtained most of the reinforcers from PW at FR 1 (*Log L)* but $P_{max}$ was highest for W. The findings were counter-intuitive with the values of reinforces established during a previous preference assessment phase showing that W was the most valued, followed by HPW and then PW.

Flevill (2002) suggests that it maybe the amount of food consumed as weight other than the number of reinforcers obtained that might be important thus this experiment replicates Flevill study but also include weight as measure of the total amount of food consumed for two reinforcers, W and PW, across a range of FR schedules. This started at FR 1 and the ratio was doubled every session until no reinforcers were obtained. The number of reinforcers obtained and weight of food eaten were recorded. The three models separately proposed by Hursh, et al., (1988), Hursh and Winger (1995) and Hursh and Silberberg (2008) were fitted to the data. The parameter estimates obtained from each model was examined and compared to evaluate the reinforcer value.

## Methods

Subjects

Six hens (Brown Shavers), numbered 101 to 106, served as subjects. All hens had been previously trained to peck a response key. The hens were maintained at 80% (+/- 5%) of their free-feeding body weight through daily weighing and post-session supplementary feeding of commercial hen feed pellets (The Animal Feed Barn™) when necessary. All hens were individually housed in home cages where they had free access to water with a 12:12-h light: dark cycle, with light beginning at 6 am. Approximately 1-2 g of NRM Shell Grit ™ was given to the hens with the regular feed pellets once a week as a nutritional supplement.

Apparatus

The experimental chamber measured 620-mm long, 580-mm wide and 540-mm high internally, and the interior was painted matte white. The base of the chamber consisted of a removable galvanized steel tray covered by wire mesh. A response key (30-mm in diameter, made from semi-translucent Perspex) that could be illuminated white was mounted on one wall of the chamber, 260-mm from the rear wall and 380-mm from the chamber floor. The key was surrounded by an aluminum plate with dimensions 70-mm wide by 140-mm long. When a response was detected a buzzer mounted behind the key emitted a brief audible beep of 65db following each effective key peck.

A food hopper opening (100-mm high by 70-mm wide), the top of which was situated 180-mm below the middle of the response key, allowed 3-s timed access to the reinforcers when the hopper was activated. The hopper opening was illuminated with white light and the key light was turned off during reinforcer delivery. The food magazine rested on an Atrax BH-3000 digital scale outside the chamber. The weight of the food was recorded on a second by second basis.

Experimental events were controlled and recorded by a IBM-compatible computer interfaced with a MED® programmable control board running MED 2.0® software (MED Associates, St. Albans, VT), that was located in the same room as the experimental chamber.

Procedure

Prior to beginning the first condition and each change of condition all hens were given 4 sessions exposure to an FR 20 schedule that was in effect for 40-min of exposure to the illuminated key (or 40 min key-time). Session duration was not contingent on the number of reinforcers the hen earned and excluded the magazine operation time. Experimental sessions were scheduled for seven days a week and took place between the hours of 7 am and 2 pm.

In Condition 1 wheat was available on an FR schedule were presented to the hens in an ascending order and each schedule was presented for a single session on each of three passes through the series (term as Runs). The FR schedules from FR 1, FR 2, FR 4, FR 8, FR 16, FR 32, FR 64, FR 128, FR 256, FR 512, FR 1024 and FR 2048. When the hen failed to receive a reinforcer in any session, the same FR schedule was re-presented for another session. Each hen's exposure to an FR series was terminated after receiving zero reinforcers for two consecutive sessions at the same FR schedule. The hens were then exposed to the FR 20 schedule for 3-4 sessions before exposure to the ascending series of FR values for a second time and then repeated for a third time. The procedures for

Condition 2 were the same as Condition 1 with PW replaced W as the reinforcer. Thus all hens were exposed to six series of the FR schedules in total for Experiment 1. For the first three exposures (Condition 1) to the series the responses were reinforced with access to W and for the last three exposures (Condition 2) to the series the responses were reinforced with access to PW.

Sometime at low ratios the actual session time was very long range from 50 min to71 min. At these times it was necessary to conduct sessions for 3 hens on one day and 3 on the next day so that each could complete 40-min of key time.

**Results**

The raw data collected for the three exposures; Run 1, Run 2 and Run 3 of W (Wheat Condition 1) and PW (Puffed Wheat Condition 2) for all hens were presented in the appendix A. Run 1 of Condition 1 and Condition 2 served as training for the hens and so only the data from Run 2 and Run 3 were used in the analysis.

The overall response rate (ORR) was calculated by dividing the number of responses by the key-time. Key-time was derived from subtracting the magazine operating time from the total session time. Figure 2 shows the ORR at each FR of Run 2 and 3 of W for each hen and the averages of the two runs plotted against the FR values on a logarithmic scale, shown in Figure 3. For both runs the ORR increased as the FR increased to around FR 8 to FR 128 with the majority of response rates across all hens peaking at around FR 64, except for Hen 103, and then decreasing with further increases in FR value. The response rate for Hen 103 increased across all FR values. The data from the two runs are similar and are well represented by the averages shown in Figure 3. Figure 4 shows the ORR at each FR for Run 2 and 3 of PW for each hen and the average of the two runs is shows in Figure 3. With PW the ORR increased as the FR increased reaching the highest response rate at around FR 16 and FR 32 for all hens but Hen 103, then the ORR decreased as the FR values increased further. The response rate for Hen 103 increased more gradually to FR 8, remained unchanged and then decreased from FR 64 and FR 128. The data from the two runs are similar and are well represented by the averages shown in Figure 3. Figure 3 allows comparison of the ORR across the two foods. The ORR for W was lower than PW from FR 1 to FR 32 or FR 64. Thus, as the ratio continued to increase the ORR for PW dropped faster than for W so that the ORR for W was now higher than that for PW. Hen 101 showed consistently slower ORR for W than PW across all FR values.

The running-response rate (RRR) was calculated by dividing the number of responses per session by the key-time minus the PRP and the time to the first response in a session. No RRR can be calculated for FR 1. Figure 5 shows the RRR for each FR of Run 2 and Run 3 for W for each hen and the averages of the RRR for the two runs are shown in Figure 6. RRR decreased as FR increased for most hens (Hen 103 the exception). The data from the two runs are similar and are well represented by the averages shown in Figure 6. Figure 7 shows the RRR at each FR of Run 2 and Run 3 for PW for each hen and the averages of the two runs is shown in Figure 6. The RRR for PW decreased as the FR increased. The data from the two runs are similar and are well represented by the averages shown in Figure 6. Figure 6 shows the RRR for W was generally lower than PW over FR values from FR 2 to FR 64. Only Hen 106 showed a higher RRR for W (this was at FR 2). Five hens responded to higher FR values with W than with PW and the RRR for PW was lower than that for W at the large FR values.

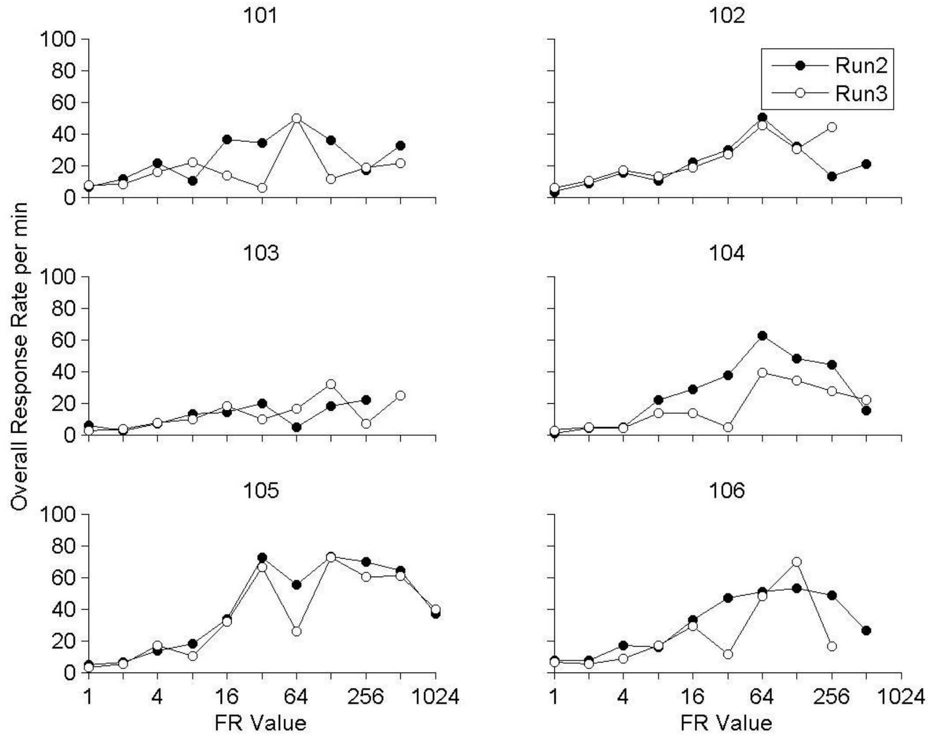


*Figure 2.* The overall response rate for wheat condition.

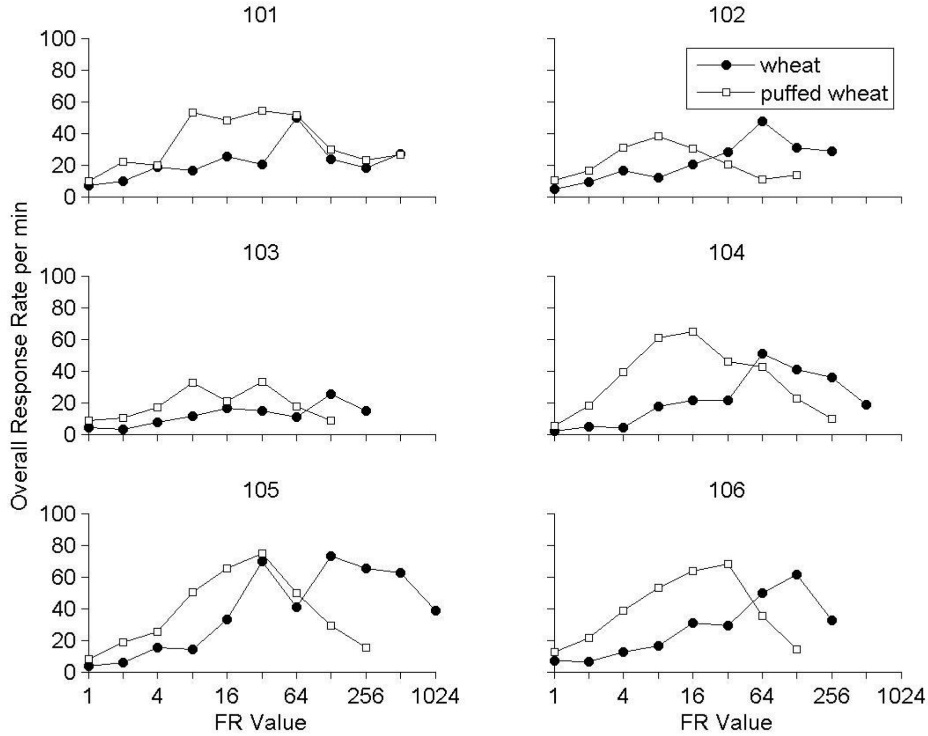


*Figure 3.* The overall response rate for wheat and puffed wheat conditions.

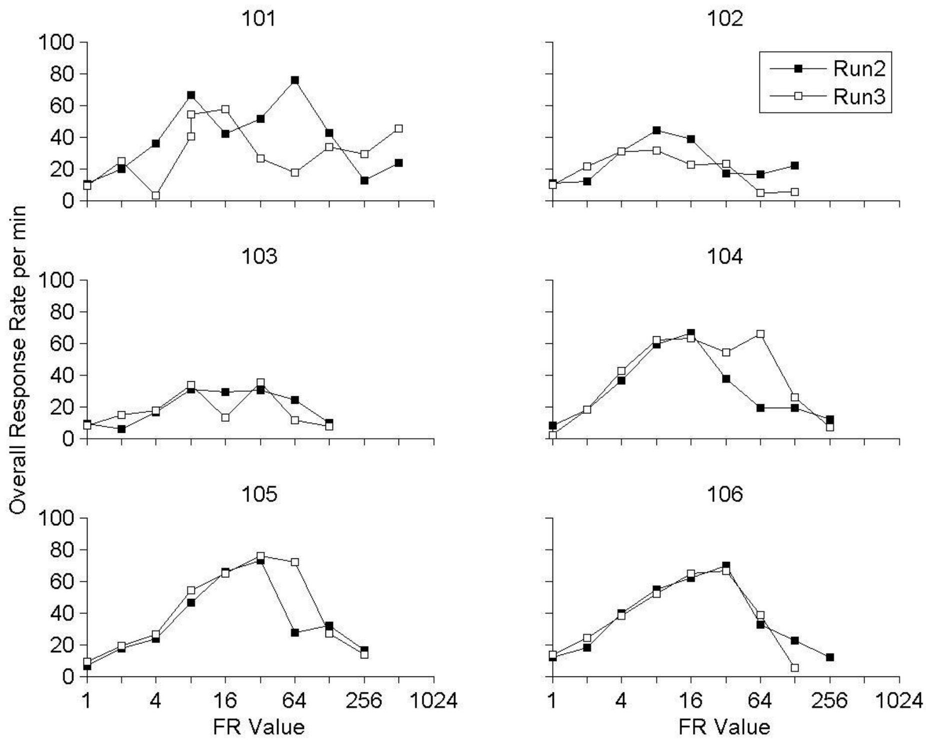


*Figure 4.* The overall response rate for puffed wheat condition.

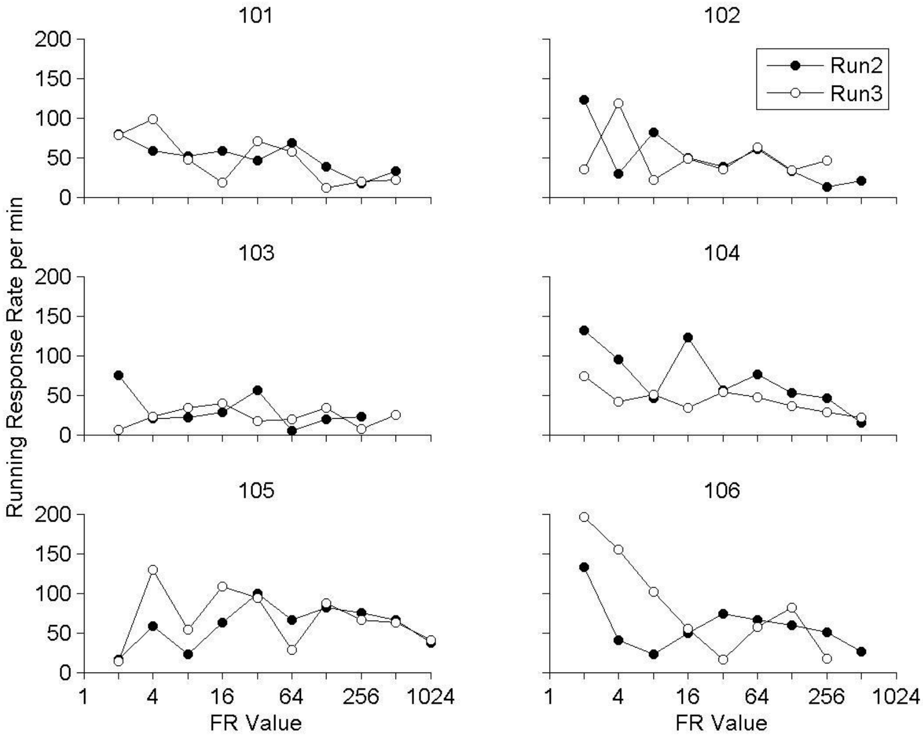


*Figure 5*. The running response rate for wheat condition.

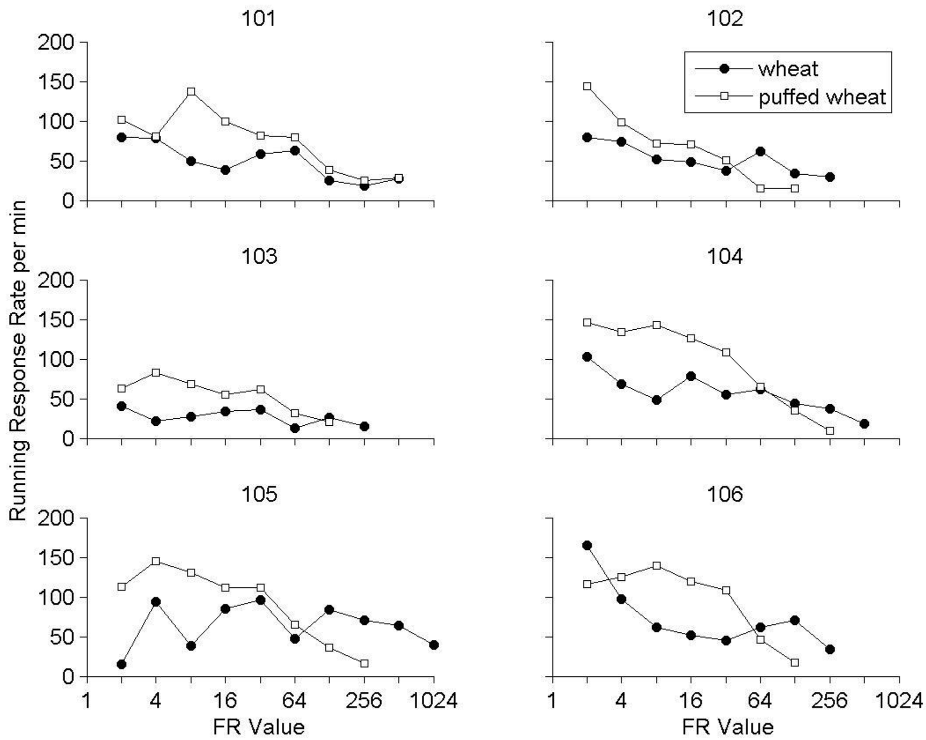


*Figure 6.* The running response rate for wheat and puffed wheat conditions.

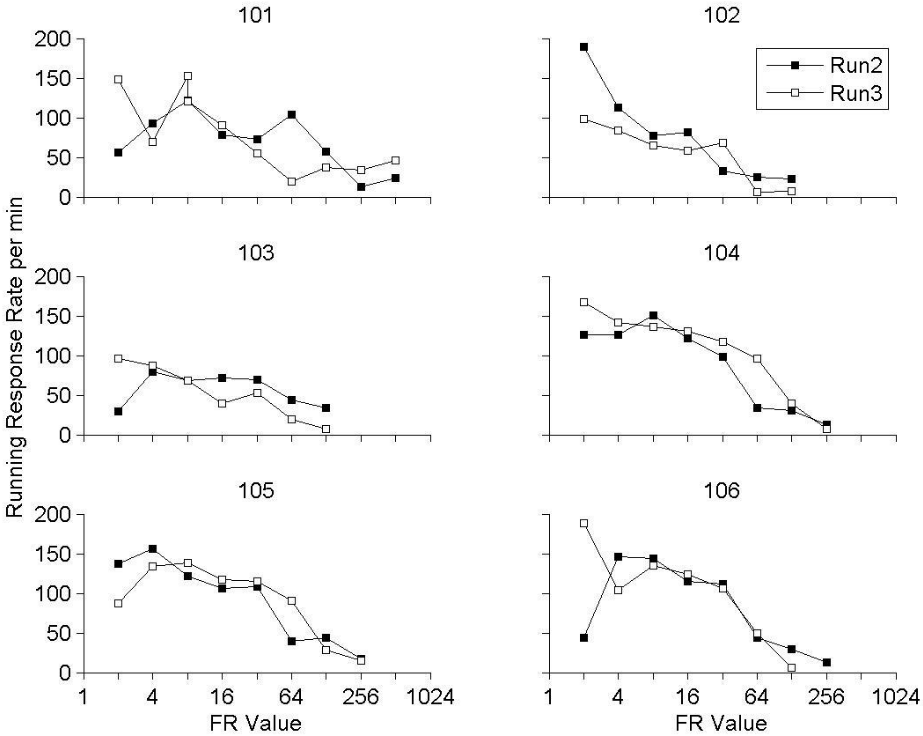


*Figure 7.* The running response rate for puffed wheat condition.

The post-reinforcement pause (PRP) is the period of non-responding after the reinforcer delivery up to the first response of the next FR schedule. It was calculated by dividing the total duration of the PRP in the session by the number of reinforcers obtained at each FR value. Figure 8 shows the PRP at each FR of Run 2 and 3 of W for each hen and the averages of the two runs are shown in Figure 9. The PRP at small FRs (FR1 to FR 16) were short of four hens, Hen 101 had her longest PRP (315-s) at FR 32 and Hen 104 at FR 32 (364-s). Hen 103 had some long PRP of 80-s at FR 32 and 70-s at FR 256. The data from the two runs are similar and well represented by the averages shown in Figure 9. Figure 10 shows the PRP at each FR of Run 2 and 3 of with PW for each hen and the averages of the two runs are shown in Figure 9. Shorter PRP of less than 20-s were observed for Hens 102, 104, 105 and 106 from FR 1 to FR 32 and as the FR value increases longer PRP were observed. Hens 101 and 103 had long PRP (50-s) at FR 4 and FR 16. Some extremely long pauses were observed 635-s at FR 128 for Hen 102, 574-s at FR 128 for Hen 103. The data from the two runs are similar and well represented by the averages shown in Figure 9. Figure 9 shows the PRP for W was generally longer than PW at small FRs (from FR 1 to FR 32) but at large FRs (FR 64 and larger) the PRP for PW were longer.

The number of reinforcers obtained in a session for each FR value is plotted as the function of the FR values (with the FR shown on a logarithmic scale). Figure 11 shows the data for Run 2 and Run 3 for W and the average of these is shown in Figure 12. Most reinforcers were obtained at FR 1, FR 2 or FR 4 and then decreases as the FR increases for each hen. The data from the two runs are similar. Figure 13 shows these data of Run 2 and Run 3 for PW for each hen and the averages are in Figure 12. Again the largest number obtained was from FR 1, FR 2 or FR 4 and the number decrease as the FR increases. Figure 12 shows the number of reinforcers obtained with W were lower than PW from FR 1 to FR 64 for all hens but after this the hens obtained lesser PW as reinforcer than W. The number of PW reinforcers obtained decreased more steeply than the number of W reinforcers obtained as FR increased.

The total weight of reinforcers delivered per session for each FR value is plotted as the function of the FR values (on a logarithmic scale) in Figure 14. This shows the weight of reinforcers for Run 2 and Run 3 for W and the averages of the two runs are in Figure 15. The weight for both runs is similar at FR 1, FR 2 or FR 4 and decreases as the FR increased for all hens. Figure 16 shows the weight of PW for Run 2 and Run 3 for each hen and the averages are shown in Figure 15. The weight obtained increases from FR1 to FR 4 and then decreases as the FR increases. Figure 15 shows that the weight of the W eaten was much higher than that of PW across all FR values for all hens.

Figures 17, 18, 19, 20 and 21 present the natural logarithms of the consumption measures (the numbers of reinforcers and weight of food) plotted against the natural logarithms of the FR values for each hen and for each food averaged across Runs 2 and 3. All graphs are presented in the format of a four by six matrix with the left two columns showing the numbers of reinforcers and the right two columns showing the weight of food. The scales on the x-axis for the number and weight differ, but both are set so that a slope at 1 would be at 45 degrees. The demand functions shown are those from fitting various functions to the data using the non-linear regression. The curvilinear demand functions were produced for both the number of reinforcers and the weight of food consumed.

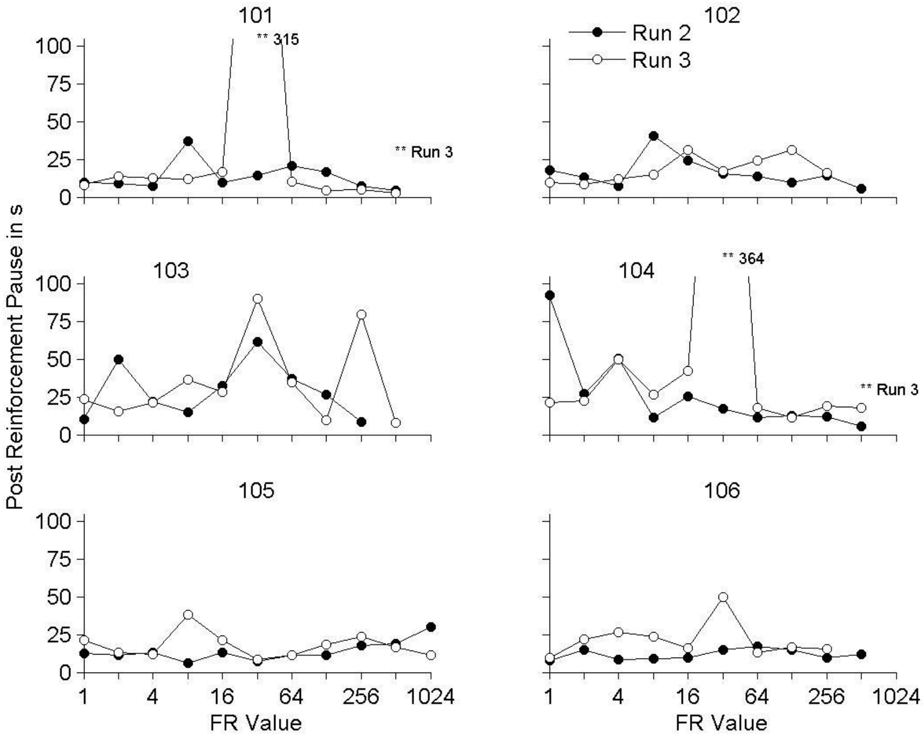


*Figure 8*. The post reinforcement pauses for wheat condition.

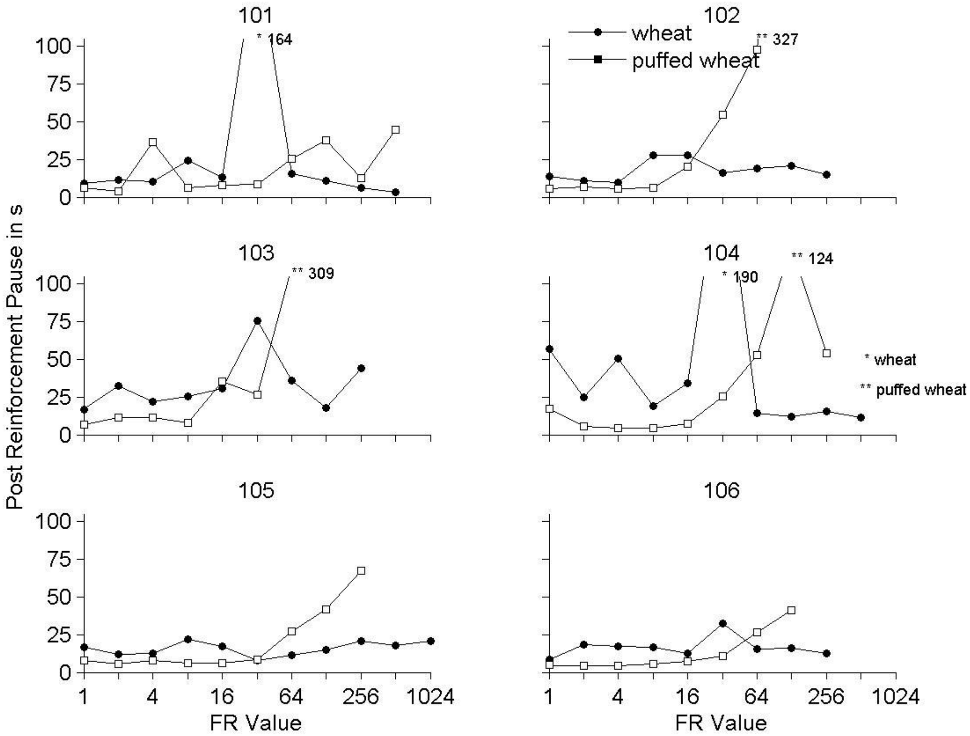


*Figure 9.* The post reinforcement pauses for wheat and puffed wheat conditions.

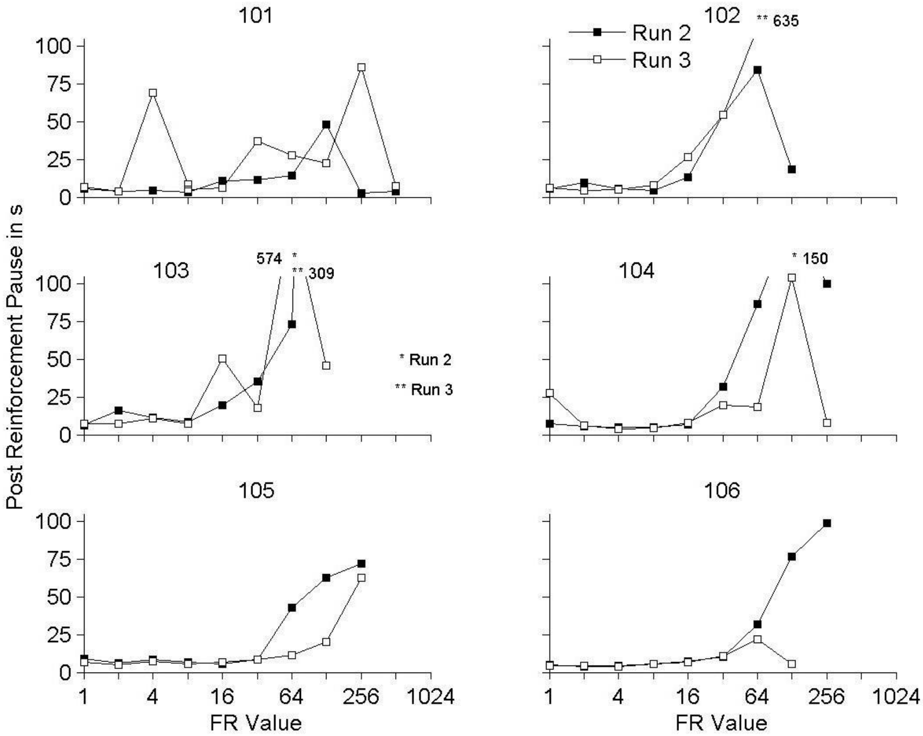


*Figure 10.* The post reinforcement pauses for the puffed wheat condition.

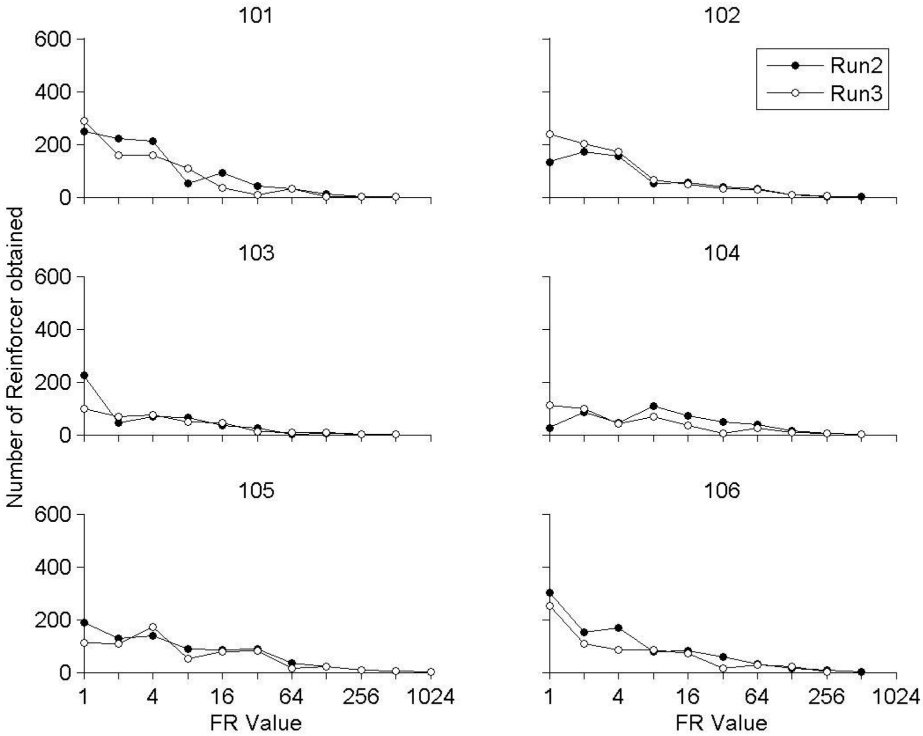


*Figure 11*. The number of reinforcers for wheat condition.

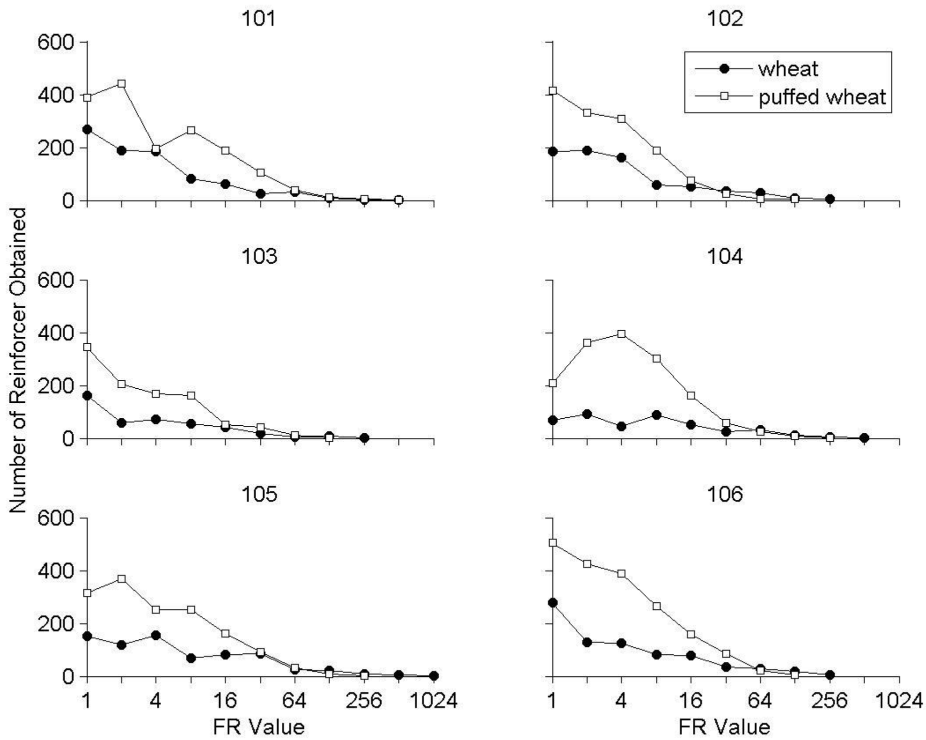


*Figure 12*. The number of reinforcer for wheat and puffed wheat condition.

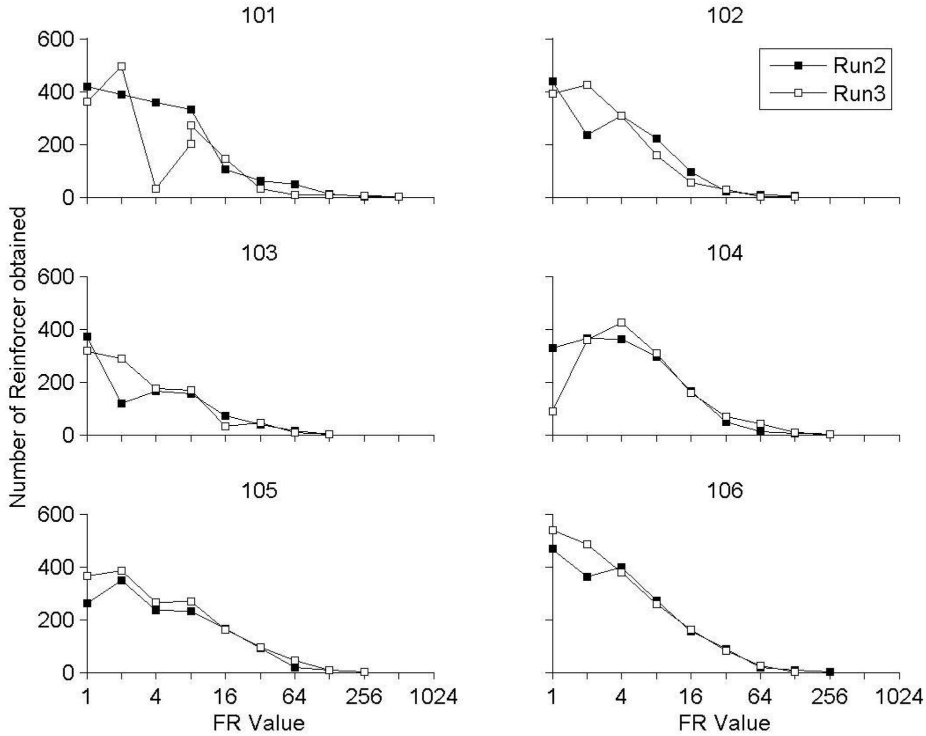


*Figure 13*. The number of reinforcers for puffed wheat condition.

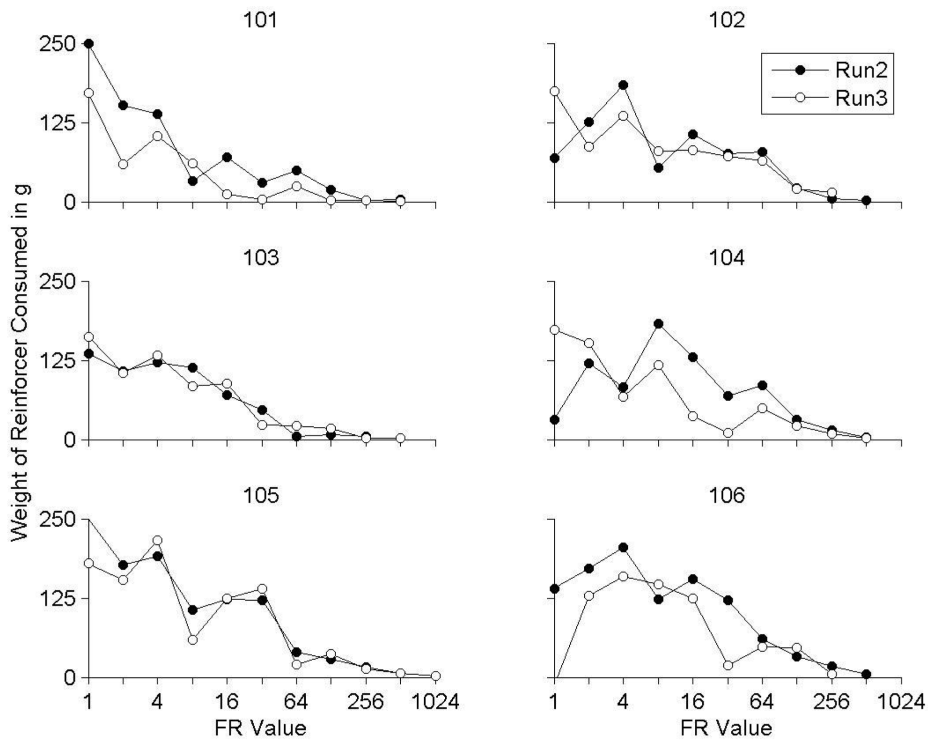


*Figure 14*. The weight of reinforcer for wheat condition.

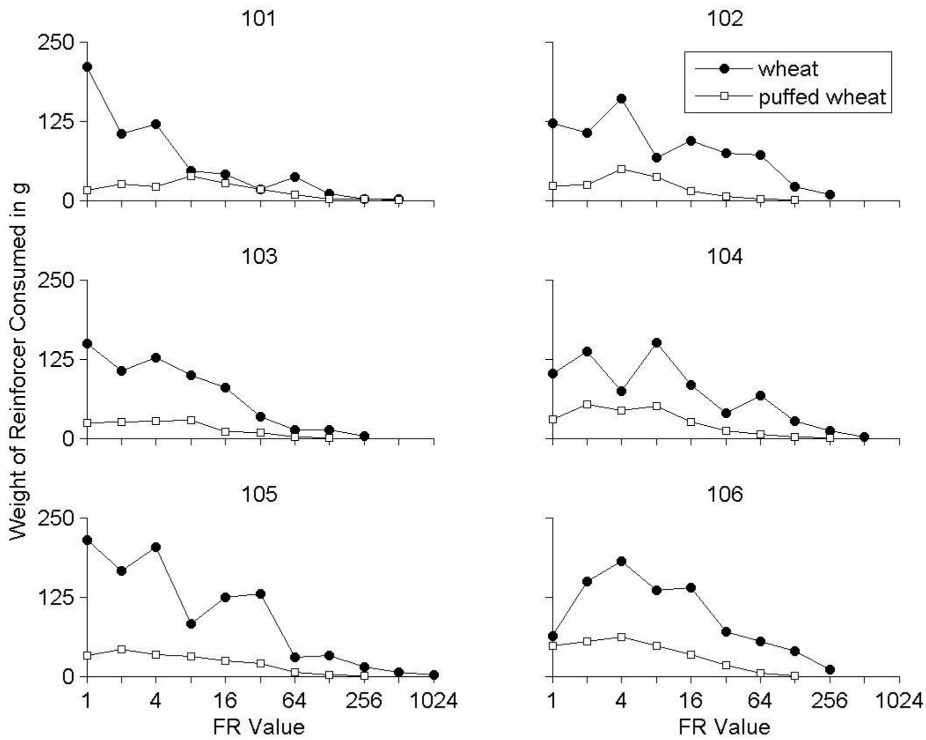


*Figure 15*. The weight of reinforcer for wheat and puffed wheat condition.

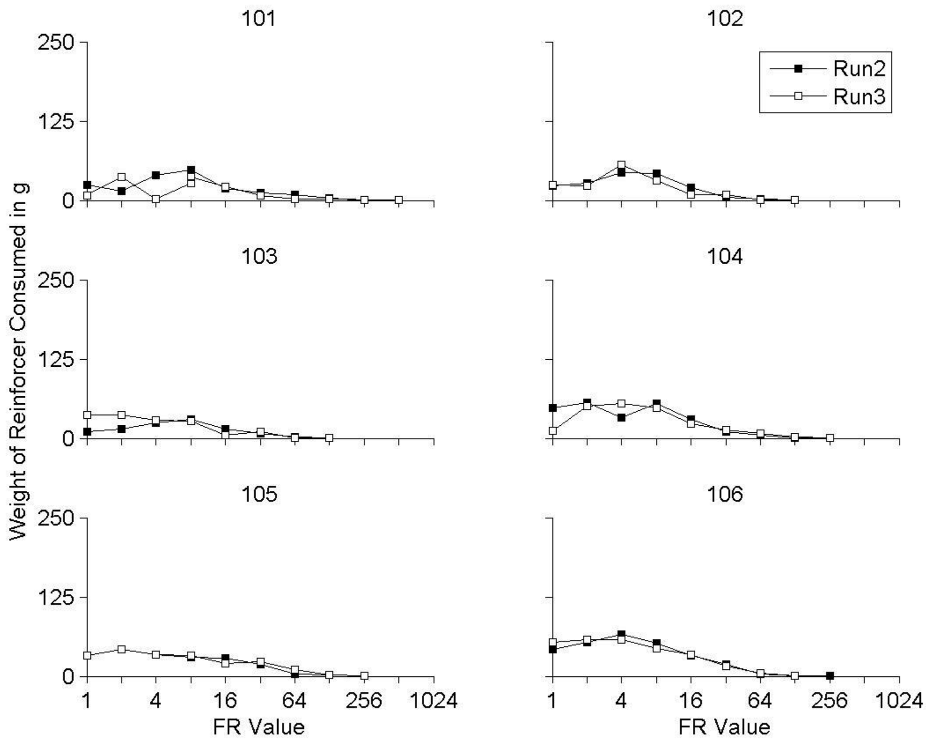


*Figure 16*. The weight of reinforcer for puffed wheat condition.

Figure 17 shows the functions obtained by fitting Equation 1 to the data natural logarithms of the consumption plotted as the function of natural logarithms of the FR values with Equation 1 fitted to the data. The parameter estimates of *Ln (L), a, b,* $P_{max}$, the percentages of variance accounted for the regression lines *(% VAC)* and the standard error of the estimates *(se)* were presented in Table 1. The functions in number of reinforcers fitted well to the W data with above 95 *%VAC* and the *se* is less than 0.34. The functions are also well fitted to the PW data with above 95 *%VAC* and the *se* of smaller than 0.39 for all hens. All initial slopes indicated by *b* values (numbers of reinforcers) recorded were small negative values but were greater than -1.0, consistent with inelastic initial demand. The *b* values for W (-0.19 to -0.68) and for PW (-0.30 to -0.71), sharing PW was more inelastic at small FRs. All *a* values were small and positive, W (0.0028 to 0.0065) and PW (0.0043 to 0.028), indicating the demand functions become more elastic as FR increases as shown in Figure 17. The $P_{max}$ was the FR value corresponding to the highest ORR, the values of $P_{max}$ for W were from 93.98 to 230.23 and PW were 18.54 to 99.24, $P_{max}$ for W was higher than PW. The values of *Ln (L)* for W were 4.44 to 5.84 and for PW from 5.84 to 6.41, *Ln (L)* for PW was higher than W.

The functions in weight fitted well to the W data with above 92 *%VAC* and the *se* is less than 0.43. The functions also fitted well to the PW data with above 87 *%VAC* and the *se* of less than 0.49 for all hens. All initial slopes indicated by the *b* values (weight) recorded were small negative values but greater than -1.0, showed inelastic initial demand. The *b* values for W (-0.09 to -0.57) and PW (-.04 to -0.25), W was more negative so more inelastic at small FRs than PW. All *a* values were small and positive, W (0.0023 to 0.0087) and PW (0.0051 to 0.034) a for W was smaller than PW, indicating the demand for PW was more elastic as

FR increases, also shown in Figure 17. The values of $P_{max}$ for W range from 85.63 to 247.97 and for PW from 28.29 to 156.19, $P_{max}$ for W was higher than PW. The values of *Ln (L)* for W (4.82 to 5.53) and for PW (3.40 to 4.10), *Ln (L)* for W was higher than PW.

Figure 18 shows the function with Equation 3 fitted to the data. The parameter estimates of *Ln L1, a1* and $P_{max1}$ from the normalized process were also presented in Table 1. This normalised consumption was calculated by multiplying each consumption value by 100 and divided the product by the consumption obtained at FR 1. Normalising consumption changed the values of *a*, Ln *L* and $P_{max}$ of the data set when fitted with Equation 1. This parameter estimates from the normalized data were referred as *a1,* Ln *L1* and $P_{max}$ 1 in Table 1. Ln *L1* values for the numbers of reinforcers were set around 4.70 to 5.52 for W and around 5.16 to 5.99 for PW. The values of *a1* were small and positive, (0.0011 to 0.0095) for W and (0.0011 to 0.0084) for PW, indicating the demand functions become more elastic as FR increases as shown in Figure 18. The values of $P_{max1}$ for W (85.10 to 346.47) and for PW (80.77 to 387.05), $P_{max}$ 1 for W was higher than PW. When weight of food was used as the consumption Ln *L1* values for W were 4.64 to 5.22 and for PW were 4.71 to 4.91. The values of *a1* were small and positive, (0.0011 to 0.0167) for W and (0.0448 to 0.3124) for PW, indicating the demand functions of PW were elastic as shown in Figure 18. The values of $P_{max1}$ for W (54.54 to 533.60) and for PW (2.55 to 18.29), $P_{max}$1 for W was higher than PW. The normalized $P_{max}$1 values for PW with weight of food as consumption were very small suggesting that PW did not maintain the behaviours.

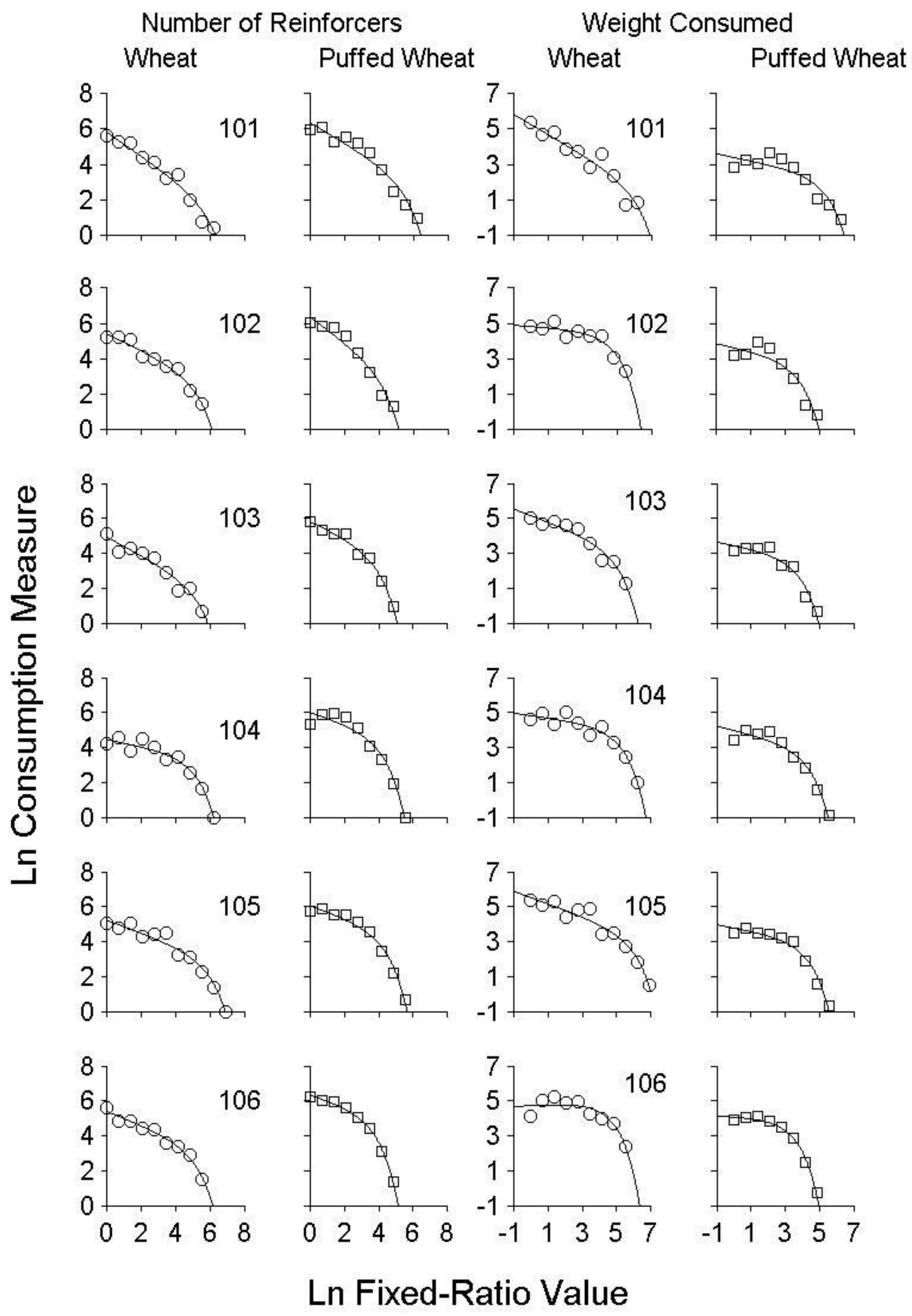


*Figure 17.* The natural logarithms of the consumption data (the number of reinforcers as the left two panels and weight of reinforcers on right two panels) plotted against the natural logarithms of the FR values for each hen across two conditions, W indicated by circles and PW indicated by squares. The smooth lines are the best fits of Equation 1 to the data

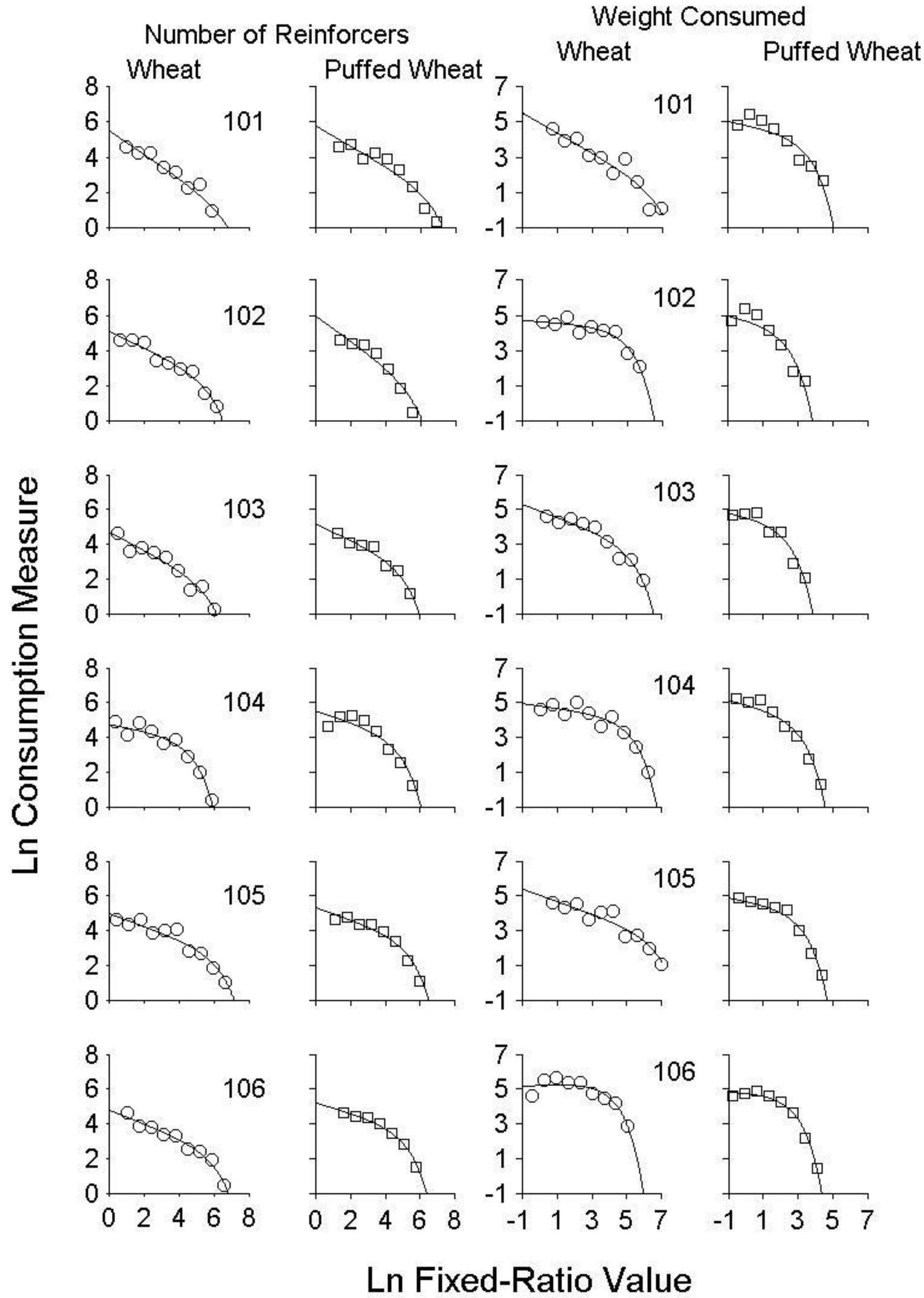


*Figure 18.* The natural logarithms of the consumption data (the number of reinforcers as the left two panels and weight of reinforcers on right two panels) plotted against the natural logarithms of the FR values for each hen across two conditions, W indicated by circles and PW indicated by squares. The smooth lines are the best fits of Equation 3 to the data.

Table 1.

*The parameters and $P_{max}$ values from Equation 1 and Equation 3.*

The parameters *Ln(L)*, b, a, *Pmax, se* and *%VAC* from fitting Equation 1 (Hursh et al.,1988) to the data of the averages from Run 2 and Run 3 in numbers of reinforcers and weight of reinforcers as consumption of each hen across Condition 1 (W) and Condition 2 (PW). The parameters *Ln (L1)*, a1, *Pmax1* from fitting Equation 3 (Hursh and Winger, 1995) to the data are also shown

| Hens | *Ln*(*L*) | *a* | *Pmax* | *b* | *se* | *%VAC* | *Ln*(*L*1) | *a*1 | *Pmax* 1 |
|---|---|---|---|---|---|---|---|---|---|
| **Number of Reinforcers** | | | | | | | | | |
| Wheat | | | | | | | | | |
| 101 | 5.84 | 0.0030 | 108.81 | -0.68 | 0.34 | 96.29 | 5.52 | 0.0011 | 292.57 |
| 102 | 5.64 | 0.0046 | 96.82 | -0.56 | 0.20 | 97.74 | 5.09 | 0.0016 | 280.39 |
| 103 | 4.93 | 0.0051 | 93.98 | -0.53 | 0.30 | 94.93 | 4.70 | 0.0031 | 152.22 |
| 104 | 4.44 | 0.0065 | 124.23 | -0.19 | 0.26 | 96.41 | 4.75 | 0.0095 | 85.10 |
| 105 | 5.23 | 0.0028 | 230.23 | -0.37 | 0.27 | 96.95 | 4.97 | 0.0018 | 346.47 |
| 106 | 5.39 | 0.0062 | 97.79 | -0.40 | 0.18 | 97.73 | 4.78 | 0.0022 | 270.93 |
| Puffed wheat | | | | | | | | | |
| 101 | 6.39 | 0.0043 | 99.24 | -0.58 | 0.39 | 95.24 | 5.81 | 0.0011 | 387.05 |
| 102 | 6.41 | 0.0157 | 18.54 | -0.71 | 0.35 | 96.05 | 5.99 | 0.0038 | 76.96 |
| 103 | 5.84 | 0.0217 | 25.14 | -0.45 | 0.19 | 98.56 | 5.16 | 0.0063 | 86.49 |
| 104 | 6.03 | 0.0174 | 38.93 | -0.32 | 0.38 | 96.17 | 5.53 | 0.0084 | 80.77 |
| 105 | 6.07 | 0.0143 | 45.63 | -0.35 | 0.24 | 98.12 | 5.33 | 0.0046 | 143.06 |
| 106 | 6.35 | 0.0281 | 24.92 | -0.30 | 0.11 | 99.55 | 5.21 | 0.0056 | 125.61 |
| **Weight of Reinforcers** | | | | | | | | | |
| Wheat | | | | | | | | | |
| 101 | 5.29 | 0.0023 | 185.87 | -0.57 | 0.43 | 91.93 | 4.98 | 0.0011 | 390.25 |
| 102 | 5.01 | 0.0079 | 109.14 | -0.14 | 0.25 | 91.96 | 4.64 | 0.0044 | 194.04 |
| 103 | 5.17 | 0.0073 | 85.63 | -0.37 | 0.27 | 95.26 | 4.92 | 0.0049 | 127.77 |
| 104 | 4.82 | 0.0059 | 145.96 | -0.14 | 0.28 | 94.31 | 4.81 | 0.0058 | 149.10 |
| 105 | 5.53 | 0.0026 | 247.97 | -0.36 | 0.32 | 95.66 | 5.04 | 0.0012 | 533.60 |
| 106 | 5.10 | 0.0087 | 105.23 | -0.09 | 0.18 | 95.71 | 5.22 | 0.0167 | 54.54 |
| Puffed Wheat | | | | | | | | | |
| 101 | 3.40 | 0.0051 | 156.19 | -0.20 | 0.45 | 86.80 | 4.85 | 0.3124 | 2.55 |
| 102 | 3.64 | 0.0252 | 31.19 | -0.21 | 0.49 | 88.26 | 4.79 | 0.1080 | 7.28 |
| 103 | 3.46 | 0.0244 | 32.99 | -0.19 | 0.34 | 93.52 | 4.62 | 0.1026 | 7.85 |
| 104 | 3.99 | 0.0147 | 51.22 | -0.25 | 0.34 | 95.52 | 4.91 | 0.0495 | 15.24 |
| 105 | 3.79 | 0.0146 | 56.09 | -0.18 | 0.26 | 96.79 | 4.71 | 0.0448 | 18.29 |
| 106 | 4.10 | 0.0340 | 28.29 | -0.04 | 0.17 | 98.66 | 4.81 | 0.0709 | 13.57 |

Figure 19 shows the functions from fitting Equation 4 to the data with *k* left free to vary. This means there is no constraint on the value of *k*. Table 2 presents the parameter $P_{max}$, *% VAC* and the *se* for both foods and measures of consumption. For the number of reinforcer, the *%VAC* range from 91.49-96.4% and se ranges from 0.00 to 0.39 (w) and the *%VAC* from 97.79 to 99.86 and se from 0.06 to 0.26 (PW). For weight of food consumed, the %VAC ranges from 85-89 to 96.44%, se from 0.17 to 0.5 (W) , and the % VAC from 94.15 to 99.28%, se from 0.13 to 0.86, the values of *k* range from 3.56 to 9.83 (W) and 3.6 to 9.94 (PW). The values of *k* range from 3.52 to 5.62 (W) and 4.86 to 6.85 (PW). When *k* was left free to vary, the values of α also vary widely across both foods and measures, therefore α cannot be really used as a measure of value.

Hursh and Silberberg (2008) provide an electronic spread sheet for the computation of the value of *k* for data comparison and they suggested to either using the largest (max-min) value of consumption for all animals, or average (maximum) value of consumption over all animals. To determine a *k* value to use with these data the values of the maximum and minimum consumption were examined for each hen, for each food, and for each measure. These values (as shown in Table 3) from 3.52 to 5.29 for numbers of reinforcers obtained and 4.22 to 5.77 for weight of foods consumed.

Figure 20 shows the functions from fitting Equation 4 to the data with k=3.5. The parameter estimates $P_{max}$, *%VAC* and *se* are presented in Table 4. The fitted functions do not always estimate the full range of the data shown in figure 20. The data are still well described by Equation 4. For number of reinforcers, the *%VAC* ranges from 89.84 to 93.04% and se from 0.34 to 0.57 for W, *% VAC* range from 83.04 to 91.36 and *se* from 0.48 to 0.80 for PW. The values of $LnQ_o$

were between 4.19 and 5.00 for W and, between 5.40 and 6.02 for PW. *Ln* $Q_o$ for PW was larger than W for the number of reinforcers. The values of α range from 9.17E-05 to 1.95 E-04 and for W and from 6.92E-05 to 1.22E-04 for PW. The α value of PW is smaller than W. The $P_{max}$ (in the original FR value ranges from 23.26 to 91.44 (W) and 12.17 to 35.80 (PW), $P_{max}$ was higher for W.

For weight of food the *%VAC* ranges from 84.99% to 96.47% (W), se from 0.18 to 0.52(W); the *%VAC* for PW 89.20% to 94.57% and se from 0.29 to 0.5.The values of $LnQ_o$ range from 4.56 to 4,94 (W) and 3.32 to 4.08 (PW), *Ln* $Q_o$ for W are larger than PW for the weight of food. The α ranges from (9.84E-05 to 1.06-04) for W and 6.89E-04 to 2.35E-04 for PW. The α value of W is smaller than PW. $P_{max}$ ranges from 32.57 to 105.43 (W) and from 18.52 to 68.04 (PW), is also higher for W.

Figure 21 shows the functions with Equation 4 fitted to the data with k=6.5. The parameter estimates $P_{max}$, %VAC and se are presented in Table 5 with k at 6.5. The fitted functions estimate the full range of the data shown in figure 21. The data are well described by Equation 4.

For number of reinforcers, the *%VAC* ranges from 84.89% to 96.25% (W), se from 0.26 to 0.57(W); the *%VAC* for PW 93.71% to 99.77% and se from 0.08 to 0.44. The values of $LnQ_o$ range from 4.19 to 5.03 (W) and 5.55 to 6.19 (PW), *Ln* $Q_o$ for PW are larger than W for the number of reinforcers. The α ranges from (5.48E-05 to 1.46E-05) for W and 4.18E-05 to 1.35E-05 for PW. The α value of PW is smaller than W. The $P_{max}$ ranges from 43.55 to 128.14 (W) and 12.20 to 42.90 (PW) was higher for W.

For weight of food, the *%VAC* ranges from 80.42% to 94.03% (W), se from 0.18 to 0.67(W); the *%VAC* for PW 88.87% to 98.98% and se from 0.15 to 0.41.The values of $LnQ_o$ range from 4.39 to 4,89 (W) and 3.14 to 4.21 (PW), *Ln*

$Q_o$ for W are larger than PW for the weight of food. The α ranges from (9.93E-06 to 3.15E-05) for W and 7.57E-05 to 1.18E-04 for PW. The α value of W is smaller than PW. $P_{max}$ ranges from 54.51 to 140.84 (W) and 21.55 to 106.41 (PW) was higher for W.

In summary, the data were well fitted to the functions with Equations 1, 3 and 4 with above 80% of the % VAC and se of less than 0.7. The parameter estimates from the data of the number of reinforcers obtained fitted to the Equations 1 and 3 consistently indicate that the $P_{max}$ for W was higher than PW and the value of *Ln l* (or *LnQo)* was higher for PW. For the data with the weight of food consumed, the $P_{max}$ was higher for W and the value of *Ln l* (or *LnQo)* was also higher for W than PW. When Equation 4 was fitted to the data with $k$ = 3.5 and $k$ = 6.5 the values of α is smaller for PW than W for the number of reinforcers as consumption. When the data of the weight of food was compared the result was the value of $P_{max}$ for W was higher than PW and the α for W is smaller for both k=3.5 and k=6.5.

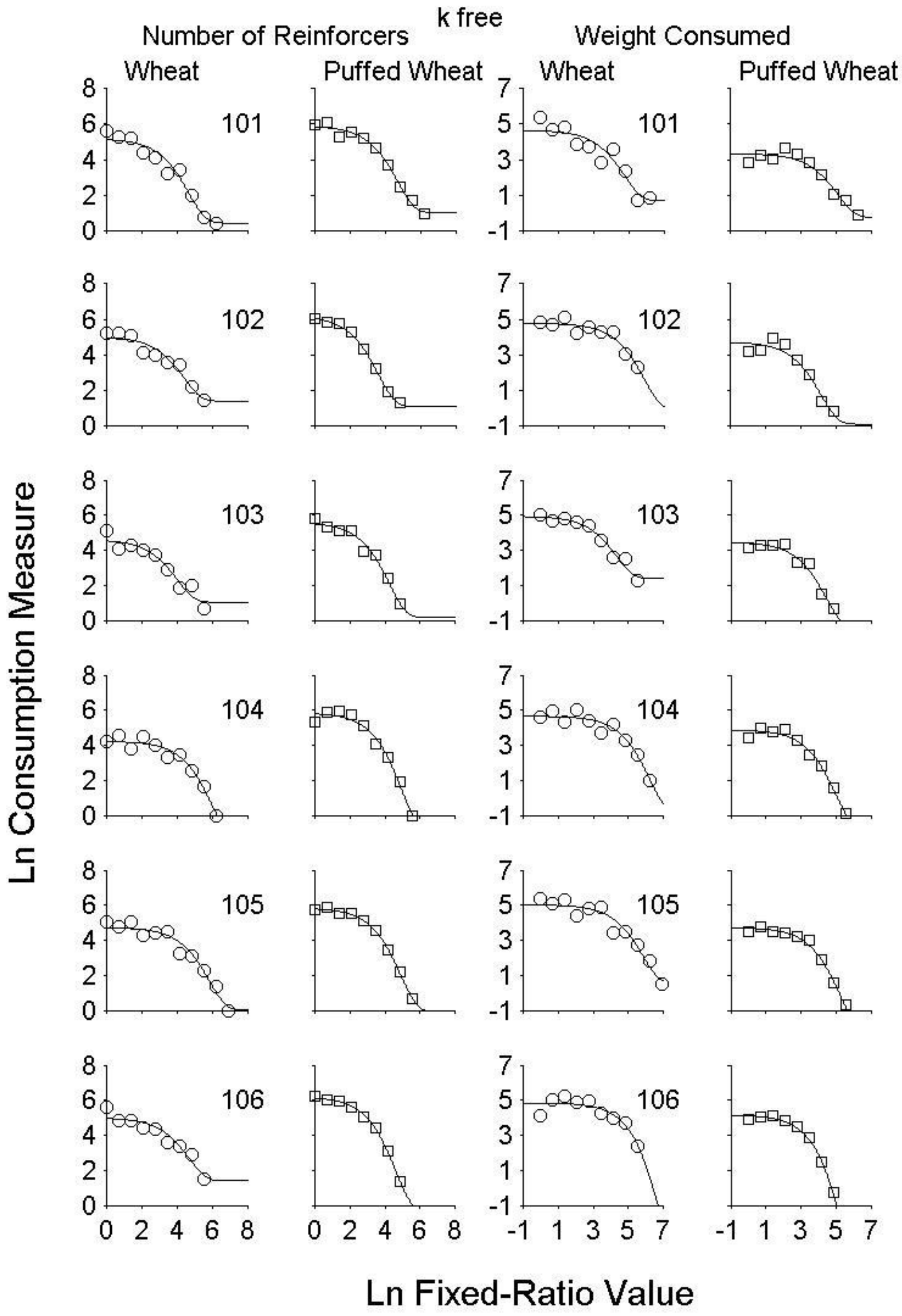


*Figure 19.* The natural logarithms of the consumption (as number of reinforcers on the left two panels and weight eaten on the right two panels) plotted against the natural logarithms of the FR values for each hen across two conditions, W indicated by circles and PW indicated by squares. The smooth lines are best fits of Equation 4 to the data when *k* was allowed to vary freely.

Table 2.

*The parameters and $P_{max}$ values from Equation 4 at k free.*

The parameter estimates *α, $Ln\ Q_0$, se, %VAC* and the values of *k* derived from the fit of Equation 4 (Hursh & Silberberg, 2008) to the averaged data from Run 2 and Run 3 of consumption (numbers of reinforcers and weight of reinforcers) of each hen for W and PW k free to vary and the predicted maximal response rate ($P_{max}$) corresponding to the FR values are shown.

| Hen | *Ln Q0* | *k* | *α* | *se* | *%VAC* | *Pmax Unit of C* |
|---|---|---|---|---|---|---|
| **Number of Reinforcers** | | | | | | |
| Wheat | | | | | | |
| 101 | 5.17 | 4.76 | 5.60E-05 | 0.36 | 95.79 | 28.03 |
| 102 | 5.01 | 3.64 | 8.47E-05 | 0.39 | 93.11 | 32.94 |
| 103 | 4.59 | 3.56 | 1.89E-04 | 0.00 | 93.00 | 23.24 |
| 104 | 4.22 | 5.62 | 3.89E-05 | 0.26 | 96.37 | 83.61 |
| 105 | 4.71 | 4.71 | 2.72E-05 | 0.31 | 96.05 | 92.58 |
| 106 | 4.99 | 3.59 | 6.50E-05 | 0.34 | 91.49 | 44.78 |
| Puffed Wheat | | | | | | |
| 101 | 5.89 | 4.88 | 2.53E-05 | 0.19 | 98.81 | 29.13 |
| 102 | 6.18 | 5.12 | 5.68E-05 | 0.06 | 99.86 | 9.09 |
| 103 | 5.57 | 5.42 | 5.59E-05 | 0.23 | 97.79 | 15.74 |
| 104 | 5.84 | 6.85 | 2.09E-05 | 0.26 | 98.19 | 24.35 |
| 105 | 5.83 | 5.92 | 2.28E-05 | 0.09 | 99.75 | 26.69 |
| 106 | 6.18 | 6.62 | 2.06E-05 | 0.08 | 99.77 | 18.16 |
| **Weight of Reinforcers** | | | | | | |
| Wheat | | | | | | |
| 101 | 4.65 | 3.98 | 8.28E-05 | 0.50 | 88.99 | 41.61 |
| 102 | 4.77 | 4.89 | 2.44E-05 | 0.27 | 92.36 | 92.79 |
| 103 | 4.93 | 3.56 | 9.48E-05 | 0.23 | 96.49 | 32.74 |
| 104 | 4.65 | 5.58 | 1.96E-05 | 0.29 | 94.10 | 108.66 |
| 105 | 5.02 | 4.50 | 2.01E-05 | 0.37 | 94.14 | 98.83 |
| 106 | 4.85 | 9.83 | 8.73E-06 | 0.17 | 85.89 | 113.55 |
| Puffed Wheat | | | | | | |
| 101 | 3.33 | 3.60 | 2.23E-04 | 0.86 | 94.61 | 68.20 |
| 102 | 3.72 | 4.65 | 3.99E-04 | 0.35 | 94.14 | 17.41 |
| 103 | 3.45 | 4.91 | 3.90E-04 | 0.26 | 96.30 | 21.60 |
| 104 | 3.87 | 5.69 | 1.47E-04 | 0.22 | 98.04 | 30.74 |
| 105 | 3.71 | 5.74 | 1.43E-04 | 0.14 | 99.13 | 36.70 |
| 106 | 4.15 | 9.94 | 7.35E-05 | 0.13 | 99.28 | 26.76 |

Table 3.

*The maximum and minimum k values.*

| **hen** | **max - min Condition1 w** | **max-min Condition 2 pw** | **average b and c** | **max-min all data** |
|---|---|---|---|---|
| 101 | 3.89 | 4.77 | 4.33 | 5.57 |
| 102 | 3.66 | 4.22 | 3.94 | 4.22 |
| 103 | 4.25 | 5.01 | 4.63 | 5.01 |
| 104 | 4.20 | 5.77 | 4.99 | 5.84 |
| 105 | 5.19 | 4.96 | 5.07 | 5.60 |
| 106 | 3.52 | 4.85 | 4.19 | 4.85 |
| means | 4.12 | 4.93 | 4.52 | 5.18 |

| | max - min all hens data both foods | | | mean max-main |
|---|---|---|---|---|
| Rts | 6.22 | | | 4.87 |
| wgt | 6.29 | | | 4.03 |
| eat | 6.35 | | | 4.52 |

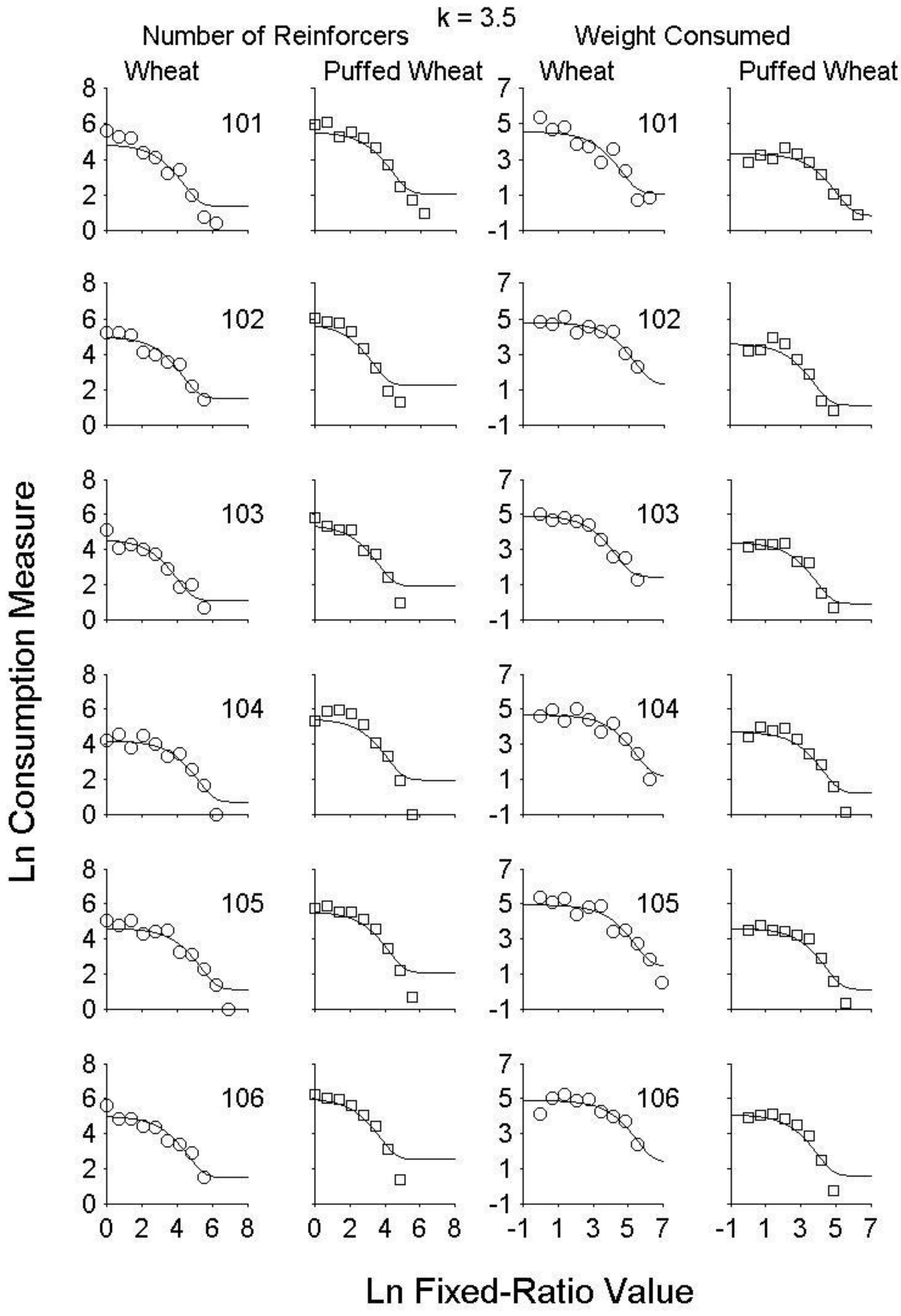


*Figure 20.* The natural logarithms of the consumption ( as number of reinforcers on the  left two panels and weight eaten on the right two panels) plotted against the natural logarithms of the FR values for each hen across two conditions, W indicated by circles and PW indicated by squares. The demand functions showed are fitted with Equation 4 with the *k* at 3.5

Table 4.

*The parameters and $P_{max}$ values from Equation 4 at k = 3.5.*

The parameter estimates *α, $Ln\ Q_0$, se, %VAC,* from fitting Equation 4 (Hursh & Silberberg, 2008) to the averaged data from Run 2 and Run 3 of consumption (numbers of reinforcers and weight of reinforcers) of each hen for W and PW with k fixed at 3.5 and the predicted maximal response rate ($P_{max}$) corresponding to the FR values are shown.

| Hen | *$Ln\ Q_0$* | *α* | *se* | *% VAC* | *$P_{max}$* *Unit of C* |
|---|---|---|---|---|---|
| **k = 3.5** | | | | | |
| **Number of Reinforcers** | | | | | |
| Wheat | | | | | |
| 101 | 4.85 | 1.03E-04 | 0.57 | 89.836 | 33.815 |
| 102 | 5.00 | 9.17E-05 | 0.39 | 93.036 | 32.562 |
| 103 | 4.58 | 1.95E-04 | 0.35 | 92.979 | 23.255 |
| 104 | 4.19 | 8.60E-05 | 0.38 | 92.079 | 78.287 |
| 105 | 4.60 | 4.86E-05 | 0.44 | 92.009 | 91.437 |
| 106 | 4.99 | 6.84E-05 | 0.34 | 91.474 | 44.119 |
| Puffed Wheat | | | | | |
| 101 | 5.55 | 4.82E-05 | 0.51 | 91.856 | 35.793 |
| 102 | 5.72 | 1.19E-04 | 0.53 | 90.961 | 12.171 |
| 103 | 5.40 | 1.22E-04 | 0.48 | 90.834 | 16.381 |
| 104 | 5.45 | 6.92E-05 | 0.80 | 83.041 | 27.667 |
| 105 | 5.57 | 5.78E-05 | 0.56 | 89.406 | 29.377 |
| 106 | 6.02 | 5.94E-05 | 0.51 | 89.917 | 18.244 |
| **Weight of Reinforcers** | | | | | |
| Wheat | | | | | |
| 101 | 4.56 | 1.06E-04 | 0.52 | 87.940 | 43.670 |
| 102 | 4.79 | 3.92E-05 | 0.27 | 91.966 | 93.986 |
| 103 | 4.93 | 9.84E-05 | 0.23 | 96.468 | 32.573 |
| 104 | 4.67 | 4.11E-05 | 0.34 | 91.784 | 101.041 |
| 105 | 4.94 | 3.31E-05 | 0.45 | 91.305 | 95.891 |
| 106 | 4.89 | 3.17E-05 | 0.18 | 84.990 | 105.427 |
| Puffed Wheat | | | | | |
| 101 | 3.32 | 2.35E-04 | 0.29 | 94.573 | 68.037 |
| 102 | 3.60 | 6.54E-04 | 0.44 | 90.714 | 18.520 |
| 103 | 3.40 | 6.89E-04 | 0.35 | 93.123 | 21.463 |
| 104 | 3.70 | 3.43E-04 | 0.50 | 90.164 | 32.029 |
| 105 | 3.60 | 3.25E-04 | 0.41 | 92.468 | 37.238 |
| 106 | 4.08 | 3.31E-04 | 0.48 | 89.197 | 22.563 |

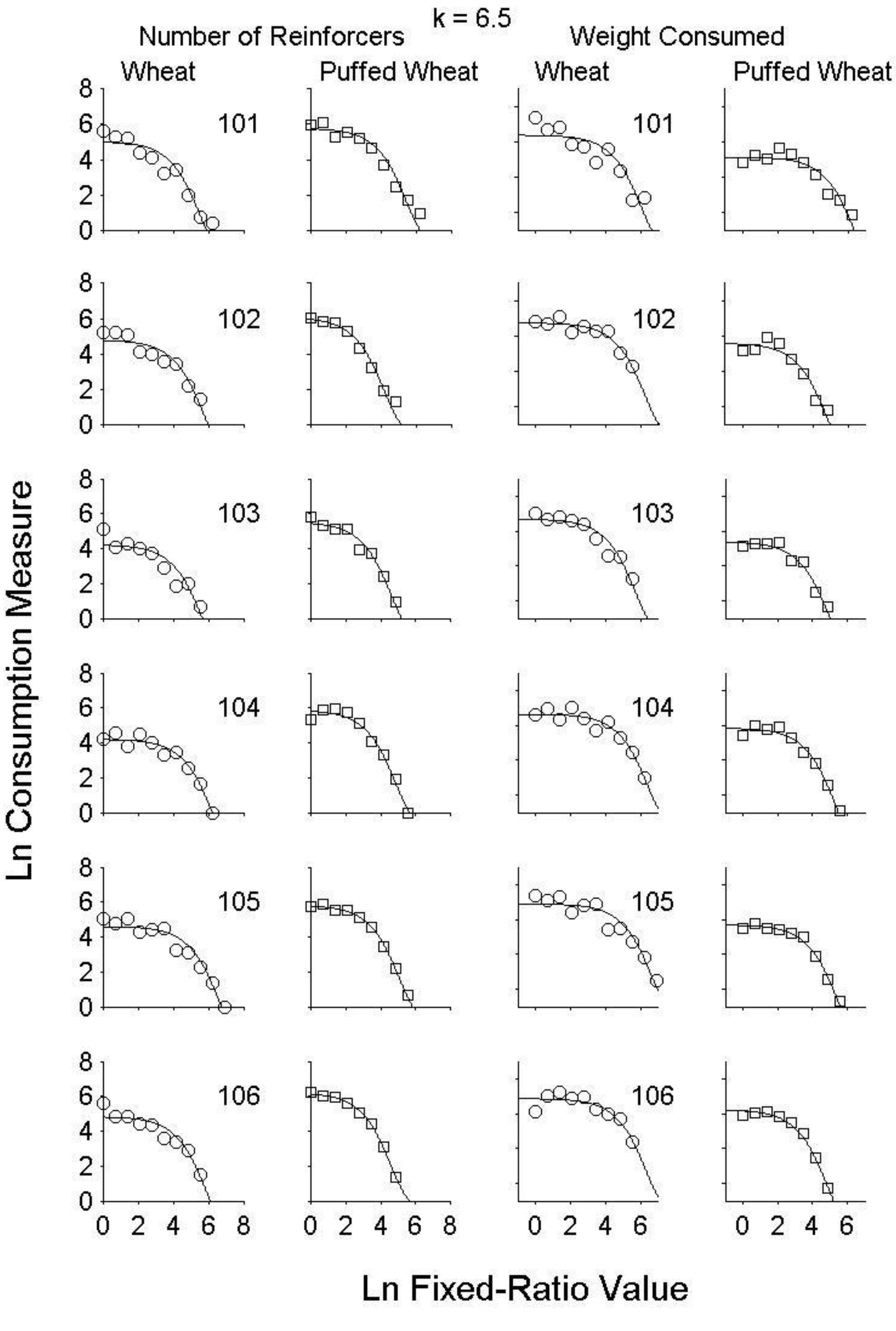


*Figure 21*. The natural logarithms of the consumption ( as number of reinforcers on the left two panels and weight eaten on the right two panels) plotted against the natural logarithms of the FR values for each hen across two conditions, W indicated by circles and PW indicated by squares. The demand functions showed are fitted with Equation 4 with the *k* at 6.5

Table 5.

*The parameters and $P_{max}$ values from Equation 4 at k = 6.5.*

The parameter estimates α, Ln $Q_0$, se, %VAC, from fitting Equation 4 (Hursh & Silberberg, 2008) to the averaged data from Run 2 and Run 3 of consumption (numbers of reinforcers and weight of reinforcers) for each hen across two conditions (W and PW) with k fixed at 6.5 and the predicted maximal response rate ($P_{max}$) corresponding to the FR values are shown.

| **Hen** | ***Ln Q0*** | ***α*** | ***se*** | ***% VAC*** | ***Pmax* *Unit of C*** |
|---|---|---|---|---|---|
| **k = 6.5** | | | | | |
| **Number of Reinforcers** | | | | | |
| Wheat | | | | | |
| 101 | 5.03 | 2.78E-05 | 0.57 | 89.50 | 43.55 |
| 102 | 4.77 | 2.95E-05 | 0.50 | 88.15 | 53.32 |
| 103 | 4.21 | 5.48E-05 | 0.52 | 84.89 | 50.16 |
| 104 | 4.19 | 3.13E-05 | 0.26 | 96.25 | 89.51 |
| 105 | 4.60 | 1.46E-05 | 0.39 | 93.76 | 128.14 |
| 106 | 4.82 | 2.43E-05 | 0.39 | 89.05 | 61.45 |
| Puffed Wheat | | | | | |
| 101 | 5.77 | 1.35E-05 | 0.44 | 93.71 | 42.90 |
| 102 | 6.05 | 3.57E-05 | 0.32 | 96.56 | 12.20 |
| 103 | 5.50 | 4.18E-05 | 0.26 | 97.33 | 18.11 |
| 104 | 5.85 | 2.29E-05 | 0.27 | 98.13 | 23.32 |
| 105 | 5.80 | 1.95E-05 | 0.11 | 99.58 | 28.80 |
| 106 | 6.19 | 2.12E-05 | 0.08 | 99.77 | 17.95 |
| **Weight of Reinforcers** | | | | | |
| Wheat | | | | | |
| 101 | 4.39 | 2.99E-05 | 0.67 | 80.42 | 77.09 |
| 102 | 4.75 | 1.70E-05 | 0.27 | 92.27 | 94.40 |
| 103 | 4.68 | 3.15E-05 | 0.37 | 91.00 | 54.51 |
| 104 | 4.63 | 1.58E-05 | 0.29 | 94.03 | 113.91 |
| 105 | 4.89 | 9.93E-06 | 0.44 | 91.54 | 140.84 |
| 106 | 4.86 | 1.41E-05 | 0.18 | 85.84 | 102.20 |
| Puffed Wheat | | | | | |
| 101 | 3.14 | 7.57E-05 | 0.41 | 88.87 | 106.41 |
| 102 | 3.59 | 2.33E-04 | 0.39 | 92.40 | 21.91 |
| 103 | 3.37 | 2.56E-04 | 0.28 | 95.66 | 24.81 |
| 104 | 3.83 | 1.19E-04 | 0.24 | 97.80 | 33.82 |
| 105 | 3.69 | 1.18E-04 | 0.15 | 98.98 | 39.38 |
| 106 | 4.21 | 1.27E-04 | 0.16 | 98.80 | 21.55 |

**Discussion**

The aim of this study was to compare the result of using the demand equations suggested by Hursh et al. (1988), Hursh and Winger(1995) and Hursh and Silberberg (2008) in assessing the reinforcer value. These demand functions were all fitted to the data.

The equation of Hursh et al. (1988) fitted the data from the wheat and puffed wheat conditions well with *% VAC* of above 86% for both measures of consumption. The parameters, a, the rate of change of slope, indicate decreases in consumption as the FR increase and b, the initial elasticity of demand showed demand was inelastic initially. When the number of reinforcers obtained was used as the consumption measures, higher initial consumption for PW. W gave the higher *Pmax*. The higher initial consumption for PW suggested that PW was valued over W. This is most likely not the case as Flevill (2002) found that hens preferred W to PW. However, the $P_{max}$ values suggest W maintained more behavior as so was more valued. This is in agreement with Flevill (2002) finding. When the weight of food eaten was used as the consumption measures, the value for $P_{max}$ was larger and the initial consumption was higher for W. This suggests that W was more valued. Thus, the conclusion drawn depends on the consumption measure used. It seems that in assessing the value of reinforcers it is important to use an appropriate measure of consumption. This make comparing reinforcers directly using the demand models complicated as it is not always the case reinforcers can be measured on a common scale. Thus, number of reinforcers is commonly used.

The Hursh and Winger (1995) normalized equation also fitted to the data well. The normalized equation transformed the value of the initial consumption level, changed the value of a, the rate of change on the slope and the value of

$P_{max}$. The findings were that using the number of reinforcers, the initial consumption for PW was higher than W. When the weight of food was used, the initial consumption with W was higher. The $P_{max}$ value for W was higher than PW with both measures. Both findings are similar to the Hursh et al.(1988) model. The normalized equation also was sensitive to the consumption measure used showing PW as more valued than W when the number of reinforcers was used and W as more valued with the weight of food.

For Hursh and Silberberg's (2008) model, the data were fitted using different *k* values. First *k* was left free to vary to get the best fits and *k* at values of 3.5 and 6.5 were used. All data were well described by the functions with above 80% of VAC. Comparing the parameter values showed that α changed with the different values of *k*, a larger *k* produces a smaller α for both the number of reinforcers and the weight of food. When *k* were set at 3.5 or 6.5,all the values of $Ln\ Q_0$ were higher for PW and the values of α were smaller for W than PW when the number of reinforcers was used as the measure of consumption. When the weight of food was used, W gave higher $Ln\ Q_0$ and the value of α was smaller for W than PW. Thus, all the models appeared to indicate PW as more value with number of reinforcers and W as more valued when the weight of food was used to measure the consumption. The $P_{max}$ for both consumption measures were larger for W suggested that W maintained responding to larger FR value. These findings were similar to the findings using the Hursh et al. (1988) and the Hursh and Winger (1995) models. When *k* was free to vary the obtained k values covered the range 3.56 to 9.94 so no singular *k* value would describe all the data equally well. This is a problem with using the essential value as α is supposed to be the single parameter for measuring the reinforcer value. This finding suggested that α cannot be the reliable single factor to access the relative value of reinforcer as it can be affected by the value of *k*. This relation between *k* and α was also reported by Foster et al. (2009). They highlighted the point that the values of *k* used for the fitting of the function would affect the shape of the function and, thus, affect the value of α alpha, the single parameter used to assess the reinforcer's values.

In this study the hens were exposed to the closed economies. However, ethnical and health concerns required post-session feeding when necessary. Thus the economy was not always closed in this regard. Foster et al. (1997) did not use large FR values and so their hens were always able to get all the food they needed in the 40 min session. The hens of the present study were exposed to larger FR values and sometime extra food was given to maintain the weight of the hens. Comparing the responses of the present hens with the hens from Foster et al. (1997) showed that the RRRs were similar. They decreased as the FR value increased but somewhat slower in the present study. The ORRs in the current study were bitonic. They increased from FR1 to FR 32, peaked between FR 32 to FR 64 and then dropped as the FR continued to increase to FR256 or higher. Foster et al, (1997) reported the ORR as somewhat bitonic. They increased from small FR with the maximum generated at FRs less than 40. This may be that increase by 20 responses each time gives the slightly different from hens responding with doubling the FR value in this study. The PRPs for the W and PW conditions in the current study were quite similar at small FRs (from FR 1 to FR 16) with short pauses, as FR increases (from FR 64 to FR 256) the pauses for PW were longer. At larger FRs the PRP for W were shorter than PW. The PRP were shorter at small FRs but as the FR increased longer PRP were found in Foster et al. (1997) study.

The consumption changes in this study were measured by the number of reinforcers obtained or the weights of food consumed. Flevill suggested weight of food eaten as the consumption measure for further study. The results of this present experiment, with the number of reinforcer obtained as the measure of consumption, was similar to the finding in Flevill (2002). However, the results with weigh as discussed earlier were more in agreement with W being the higher valued food. It could be then be that the weight measure is a better measure for comparing the value of reinforcers such as W and PW. As Flevill pointed out, W is small and compact thus at small FRs the hens would be able to eat larger amount with fewer responses. PW is larger and less compact, therefore hens might need to respond more at small FR to gain as much of the PW as they did with W. The difference was not so large with only a few reinforcers at larger FRs.

Most demand studies have used the number of reinforcers as the consumption measure. In many case number may be directly related to the amount "gained". However, in cases with research on animal's welfare the commodities or activities such as nesting or dust bathing materials may not be measured in term of number or weight. Hence, the reinforcer's access time may be used as measure of consumption. This means that a range of access times need to be studied to help interpret the data.

The shape of the demand function is the result of the response rates change as pointed out by Hursh (1980). The patterns of responding for the reinforcers in this study can be summarised as a bitonic function for both foods. The patterns seen in ORR and RRR were an increase in responding as FR increased, that perked and then decreased as the FR continue to increase. This pattern is consistent with other studies with hens demand for foods (Flevill, 2002; Foster et al., 1997; and Foster et al., 2009). A point to note was that in all these studies hens responded faster for PW when the “price” was lower (at small FR values) but the responding for PW also drop earlier at larger FR. The response rates for W at small FR values was slow but W maintained responding to a much larger FR values as compared to PW.

The PRPs at smaller FR values till FR 32 were short and as the FR increased larger PRPs were evident for all hens across both food conditions. This pattern was consistent with the pattern of PRPs responded by Felton and Lyons’ (1966) with pigeons that responded on a range of FRs from 25 to 150. Schlinger, Derenne and Baron (2008) highlighted that subjects are less likely to pause if the probability of receiving reinforcement is high for responding. For low FR values the probability of receiving reinforcement of responding is high, i.e. at FR 4 the subject is reinforced after 4 responses hence less likely to pause while at FR 20 it would take longer for the subject to be reinforced. In the current study this might be the explanation of short pauses were found at small FRs and at large FRs longer PRP was observed.

In summary the finding showed that to evaluate reinforcer value with the demand equations was not straightforward with many parameters to compare and the equations are sensitive to the measure of consumption used.

The second part of the study was to examine the value of the reinforcer with the cross-price demand function using the same subjects and the same reinforcers.

# EXPERIMENT 2

## Cross-Price Demand

Experiment 2 on the cross-price demand replicated the methodology of the methodology of the two-alternating levers procedures (Holm et al, 2007) to vary the FR-FR schedules as price change for the reinforcers.

The reinforcers were presented in two food magazines and the delivery of the reinforcers depend on which side of the response keys the hens would first complete the FR requirement associated to the key.

An experimental session consists of two components, the forced-choice trials and a 40-min of session for responding. The forced-choice trials were included for the hens to be familiar with the FR-FR schedules that were on effect for the session. (The explanation of how the forced-choice trials worked, will be explained further in the procedures section).

The aim of this experiment was to compare the method of evaluating the value of reinforcers with the CP of the linear demand fits (Sorensen et al., 2004) and the sigmoid demand fits (Holm et al., 2007) using hens.

## Methods

### Subjects

The subjects used in this experiment were the same six hens previously used in Experiment 1.

Apparatus

The experimental chamber measured 620-mm long, 580- mm wide and 540- mm high internally, and the interior was painted matte white. The base of the chamber consisted of a removable galvanised steel tray covered by wire mesh. Two side response keys (30-mm in diameter, made from semi-translucent Perspex) that could be illuminated green were mounted on the right wall of the chamber, 70-mm from the rear wall and 380- mm from the chamber floor where the two keys were positioned. Each key was surrounded by an aluminum plate with dimensions 70-mm wide by 140-mm long. When a response was detected a buzzer mounted behind the key as feedback of responses emitted a brief audible beep of 65db.

Two food hopper openings (100-mm high by 70-mm wide) which top was situated 180-mm below the middle of the response key, allowed 3-s timed access to either wheat or puffed wheat when the hopper was activated depending on the experimental condition that was in effect. The hopper opening was illuminated with white light and the key light was turned off during reinforcer delivery. Two food magazines were used, each rested on the Atrax BH-3000 digital scales outside the chamber. The weight of the food was recorded on a second by second basis. Figure 22 shows a hen in the experiment chamber, the positions of the two response-keys and the food magazines.

*Figure 22*. The experimental chamber with two response keys which lighted green when in effect, two food magazines directly below the keys delivered wheat, puffed wheat or both based on experimental conditions

Experimental events were controlled and recorded by an IBM-compatible computer interfaced with a MED® programmable control board running MED 2.0® software (MED Associates, St. Albans, VT). The device was located in the same room as the experimental chamber.

Procedure

Prior to the start of the first condition all hens were given multiple exposures to a concurrent FR 32 on the left key and FR 8 on the right key schedules for 40 min of responding.  This condition is referred to as Condition 3. The hens were given a 3-s access to Wheat as the reinforcer.  For the following session, then the FR schedule on the left key was switched to FR 8 and the FR on right was at FR 32. The session duration was not contingent on the number of reinforcers the hen earned.

The hens responded on a series of concurrent FR-FR schedules and received 3-s timed access to either wheat or puffed wheat. In Condition 1, W was presented as the reinforcers in both magazines. In Condition 2, PW was the reinforcer and in Condition 4, W was presented in the left magazine, while PW was presented in the right magazine. Nine combinations of the FR-FR schedules were chosen based on the hens' performance in Experiment 1.

The session numbers of each condition, the left FR schedules and the right FR schedule on effect for the session are presented in Table 6.

The order of presenting the pairs of FR-FR schedules across sessions was randomized for each of the conditions; however the same order of FR-FR schedules was presented again for Conditions 2 and Condition 3. Each experimental condition consisted of 9 sessions where a pair of FR values was in effect per session. An experimental session consists of 2 components, two forced-choice trials and the main session in which hens were exposed to 40 min of access to the illuminated response keys. The main session began after the forced choice trials were completed. The 40 min session excluded the magazine operation time and time of the forced-choice trials.

At the beginning of a session, the weight of the food and the magazine was recorded. Each session began with 2 forced choice trials. Both keys were lit and remained lighted until the FR schedules of the keys were sampled; i.e. when the FR of one key was completed and the reinforcer delivered. The light of the key was extinguished and remained inactive until the FR of the other key was completed and the reinforcer delivered. Then the key lights for both sides went off for 3-s and turned on again signaling the beginning of a new trial.

During the main session hens were free to response on either of the response keys. After completing an FR requirement on a key the magazine associated with the key allows 3-s access to food. When all the hens had completed all 9 sessions of the first wheat condition, the hens were exposed to three sessions of FR 8/FR 32 before a new experimental condition. The schedules with the FR 8 changes from the left keys to the right key from session to session.

Experimental sessions were schedules for seven days a week and took place between the hours of 7 am and 12 pm. The data for analysis consisted of number of reinforcers obtained by each hen for the left and right magazines, the number of responses received on the left and right keys, and the schedules on the keys.

Table 6.

*The order of the experimental sessions of each condition with the left FR schedule and the Right FR schedule on effect.*

| Session # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Condition 1. Wheat were presented on the left and on the right food magazine | | | | | | | | | |
| Left FR | 1 | 8 | 128 | 4 | 256 | 32 | 2 | 16 | 64 |
| Right FR | 256 | 32 | 2 | 64 | 1 | 8 | 128 | 16 | 4 |
| Condition 2. Puffed wheat were presented on the left and on the right food magazine. | | | | | | | | | |
| Left FR | 1 | 8 | 128 | 4 | 256 | 32 | 2 | 16 | 64 |
| Right FR | 256 | 32 | 2 | 64 | 1 | 8 | 128 | 16 | 4 |
| Condition 3: Wheat was presented on the left and puffed wheat was presented on the right food magazine. | | | | | | | | | |
| Left FR | 1 | 8 | 128 | 4 | 256 | 32 | 2 | 16 | 64 |
| Right FR | 256 | 32 | 2 | 64 | 1 | 8 | 128 | 16 | 4 |

**Results**

The raw data are presented in Appendix B. Figures 23, 24, 25 present the natural logs of the number of reinforcer (left panel) and weight eaten (right panel) plotted as against the natural logs of the FR value on the left key for each hen. These graphs necessarily exclude data when no reinforcers were obtained for that food at that price (FR value) thus, sometimes several data points are missing. The lines were fitted to the data by the method of the least squares. The solid lines and the circles are the data from the left key and the dashed lines joining the squares joining the circles are the data from the right key. The y-intercepts, the slopes, the *se*, *%VAC* of the fitted lines and the CPs for the number of reinforcers obtained and weight of food eaten are also given in Table 7, 8 and 9.The CP were calculated by finding the point where the two lines cross through solving the simultaneous equations. The *%VAC* is not high as a result the variability in the data. Generally the data of the number of reinforcers are better fits to the lines than data of weight of food eaten. All functions have EC values (i.e., the absolute value of slope) ranging from less than 1.0 to greater than 1.0 indicating the elasticity varied from elastic to inelastic over individual hens. Function 1 refers to the function fitted to the consumption measure from the left key. Function 2 refers to the function fitted to the consumption measure from the right. For all hens, except Hen 104, the consumption decreased on the left key and increased on the right key as the left FR schedule increased.

Figure 23 shows data from the W vs. W condition. The CPs of the functions was around the middle values of the series of FR schedules for both consumptions used. The exception was the CP for Hen 101 was above the middle range when weight of food was the measure of consumption. The CPs for Hen

104 was at a small FR when the number of reinforcers and the weight of food eaten were used as the consumption measures. Table 7 shows that when consumption measure was the number of reinforcers, the values of the y-intercept for Function 1 are between 4.61 and 5.76 and for Function 2 -1.80 and 3.56. The EC values range from 0.47 to 1.10. Four hens showed elastic demand, one showed unit elasticity and one showed inelastic demand. For Function 2 the EC values are from 0.23 to 1.35 with four hens showing inelastic demand and two hens showing elastic demand. The CPs (in FR) range from 17 to 23 for five hens. Hen 104 is the exception with a low CP value (at FR 5). With the weight of food eaten, the values of the y-intercept for Function 1 were between 3.88 and 5.15 and for Function 2 were -2.16 and 3.54. The EC values of the slope (Function 1) range from 0.17 to 0.82, all hens showed inelastic demand. For Function 2 the slopes were from 0.20 to 1.36 with three hens showed inelastic demand and two hens showed elastic demand. The CP values range from 16 to 25 for four hens. Hens 101 and 104 are the exceptions

Figure 24 presents data from the PW vs. PW condition. Hen 103 did not completed all the nine sessions of this condition, therefore only three data points are shown on the graphs for both measures. The data for Hen 103 were excluded from the CP analysis. The slope of Function 2, with weight of food eaten, for Hen 104 was almost parallel with the x-axis suggesting that Hen 104 kept working on the right key even when the left schedule was smaller than the right key schedule. Table 8 shows that when the number of reinforcers was used as the consumption measure, the values of the y-intercept for Function 1 are between 5.19 and 7.14 and for Function 2 are -2.07 and 3.59. The EC (slopes) of Function 1 are from 0.43 to 1.34, three hens showed inelastic demands and two hens showed inelastic demand. For Function 2 the EC values are from 0.49 to 1.63 with three hens showed inelastic demand and two hens showed elastic demand. The values of CPs range from 10 to 49 for five hens. Hen 102 is the exception, with a CP at FR 50 above the mid-range of the FR schedule. When consumption measure is the weight of food eaten, the values of the y-intercept for Function 1 are between 3.33 and 4.82 and for Function 2 are -2.71 and 3.88. The slopes of Function 1 range from 0.57 to 1.18, two hens showed inelastic demands and three hens showed elastic demand. For Function 2 the slopes are from 0.11 to 1.32 with three hens showing elastic demand and two inelastic demand. The CPs range from 3 to 82 for five hens. Hens 102 and 104 are the exceptions.

Figure 25 shows data from the W vs. PW condition. The W was presented in the left magazine and the PW in the right magazine. Table 9 shows the values of the y-intercept for Function 1 are between 5.27 and 5.92 and for Function 2 are between 1.22 and 1.77. The EC values for Function 1 are from -0.50 to 0.89, all hens showed inelastic demand and the EC of Function 2 are from 0.31 to 1.16, three hens showed inelastic demands and three showed elastic demands. The CPs range from 11 to 53 for all hens. With the weight of food eaten, the values of the y-intercept for Function 1 are between 4.63 and 5.62 and for Function 2 are -4.10 and 0.57. The slopes of Function 1 range from 0.24 to 0.70, all hens showed inelastic demands. For Function 2 the slopes are from 0.08 to 1.44, five hens showed inelastic demand and one hen showed elastic demand. The values of CP are from 37 to 505 for all hens.

Figures 26, 27 and 28 present the natural logs of the numbers of reinforcers obtained (left panel) and the weight of food eaten (right panel) plotted against the log of FR values on the left key. It should be noted that the scales shown on the graphs for the number of reinforcers obtained and the weight of food are not the same across these figures. The Equation 7 was fitted to the data from the left key using the non-linear equations. However, the following equation:

$$Y = C + [\ (D - C) / (1+ \exp\ (-g\ (\log\ (p) - \log\ (I_{50})\ ))] \qquad (8)$$

where Y is the number of reinforcers obtained, $p$ is the FR values or price. $D$ and $C$ are the lower and the upper limits of Y of the consumption. $I_{50}$ is the FR value giving 50% consumption between $D$ and $C$, and $-g$ is the slope of the non-linear curve at the $I_{50}$ point (shown in the introduction). Equation 8 is a modified version of the Equation 7 with a minus sign added to describe the data from the right key. This was fitted to the log of the consumption measures from the right key and the logs of the FR on the left key. The resulting functions are shown on the graphs with the solid lines showing the left key functions and the dashed line the right key function. All data are shown on the graphs. Tables 10, 11 and 12 show parameters, $I_{50}$ (the FR values giving 50% of reinforcers between the upper limit of Y, D, and the lower limit of Y, C), the slope of the non-linear curve at the $I_{50}$ point, the *se* and *%VAC* from the functions. The functions were fitted using the non-linear regression and all the parameter values (C, D, $g$ and the $I_{50}$) were left free to vary. The CP values as shown on the tables were estimated visually from the graphs and checked by second observer. The Function LFR refers to the data from the left key and the Function RFR refers to data from the right key. All graphs show decreases in consumption on the left key, and increase in consumption on the right key, as the FR value on the left key increased.

Figure 26 presents the data for the W vs. condition (Condition 1). The data fitted the functions well, showing the CPs for most graphs around the mid-range of the FR values. The functions for the number of reinforcers were more sigmoidal than the functions for the weight of food eaten with more flatted lines. Table 10 shows that when number of reinforcers was the consumption measure, the *%VAC* ranges from 72.0 to 99.2 and the *se* between 1.12 and 51.58. The values of $I_{50}$, which defines the shape of the function, varied widely, ranging from -14.11 to 5.81. Ten out of twelve functions had values of the slope at this point (*g*) greater than one (1.05 to 39.6) suggesting the demand was elastic. The upper (D) and lower (C) limits of the functions vary widely. The CPs are between FR 12 and FR 30 which are in the middle of the FR values. When the weight of food was the consumption measure, the *%VAC* ranges from 50.0 to 99.6 and the *se* is between 3.97 and 30.97. The values of $I_{50}$ range from -20.73 to 3.54. Most of the values of slope (*g*) were greater than one suggesting the demands were elastic. The upper (D) and lower (C) limits of the functions vary widely. The CPs (in FR value) are between 12 and 32

Figure 27 presents the data for the PW vs. PW condition (Condition 2). There is one data point for Hen 102 not shown on the figure of the number of reinforcers. The value (800) is indicated on the figure. The CPs are around the mid-FR range. Hen 103 only completed 3 sessions of Condition 2 hence only 3 data points are shown and her data was excluded from subsequent analysis. Table 11 shows that when number of reinforcers was the consumption measure, the *%VAC* ranges from 76.2to 97.6 and the *se* value are large (from 31.24 to 78.55). The values of $I_{50}$ range from -17.38 to 14.46. Most of the values of slope (*g*) of the functions are the greater than 1.0 suggesting the demand was elastic. The upper (D) and lower (C) limits of the functions vary widely. The CP is between FR 14 and FR 32. With the weight of food used as consumption measure, the *%VAC* ranges from 60.4 to 98.4 and the *se* between 3.05 and 12.05. The values of $I_{50}$ are positive ranging from 2.50 to 41.39. Most of the values of slope (*g*) are greater than 1.0 suggesting the demands were elastic. The upper (D) and lower (C) limits of the functions vary widely. The CPs are between 14 to 24.

Figure 28 presents the data for the W and PW condition. The data fit the functions well. However, when weight of food is the consumption measure the PW was so light compared to W that the PW functions are very low. Table 12 shows for the number of reinforcers obtained the *%VAC* ranges from 66.1.to 99.5 and the *se* from 2.45 to 61.58. The values of $I_{50}$ range from -46.82 to 19.71. The values of slope (*g*) for six of the functions are greater than 1.0, indicating half of the demand functions were elastic and half were inelastic. The upper (D) and lower (C) limits of the functions vary widely. The CPs are between FR 12 and FR 60, showing slight shift of the CP to a larger FR value. The *%VAC* ranges from 64.5 to 96.6 and the *se* between 1.4 and 39.84 when the weight of food was used as the consumption measures. The values of $I_{50}$ range from -107.19 to 27.53. The values of slope at this point (*g*) are greater than 1.0 for most functions, suggesting demand was elastic. The upper (D) and lower (C) limits of the functions vary widely. The CPs were between FR 18 to FR 128, showing a greater shift of the CPs to the large FRs.

Comparison of the data in Figures 26,27 and 28 and Table 10,11 and 12 show that when both foods were the same the CPs were around the point where the right key FR and the left key FR were equal (around 14 to 20) for both foods. However, a far larger number of reinforcers were obtained from both keys in the PW vs. PW than the W vs. W sessions. Also much more W was obtained (as seen in the right panel) than PW over there same conditions. In W vs. sessions the CP for number of reinforcers changed unsystematically across hens. For Hens 102,104 and 106 it remained roughly the same, for Hen 105 it got much larger and for Hen 101 it got smaller. Hen 103 did not have enough data for this comparison. When weight is taken as the consumption measure, the CP for Hen 101 got smaller, but for Hens 102,104,105 and 106 it got very much larger. Thus the change in CP with weight suggest four hens valued W more than PW but one value PW more.

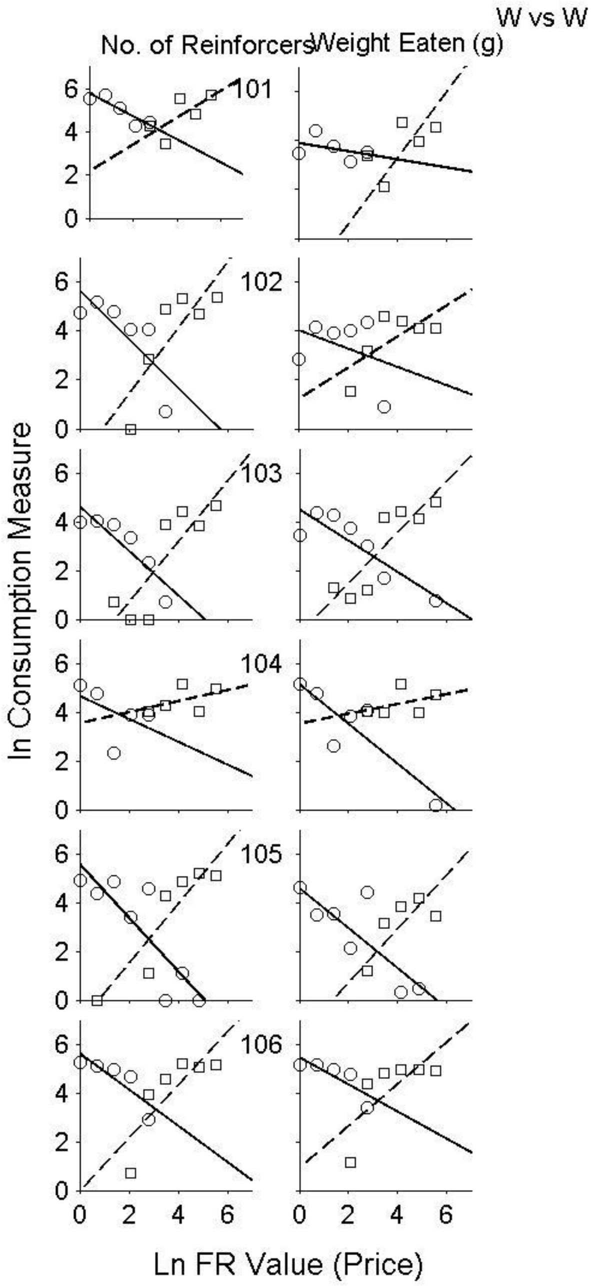


*Figure 23*. The consumption measure from the W vs. W. conditions.

The natural logarithms of the consumption measures from the left (circles) and right (squares) magazines plotted against the natural logarithms of the FR value for the left key W vs. W session. The number of the reinforcers are shown in the left panel and the weight of the food eaten in the right panel. The lines were fitted by the method of least squares

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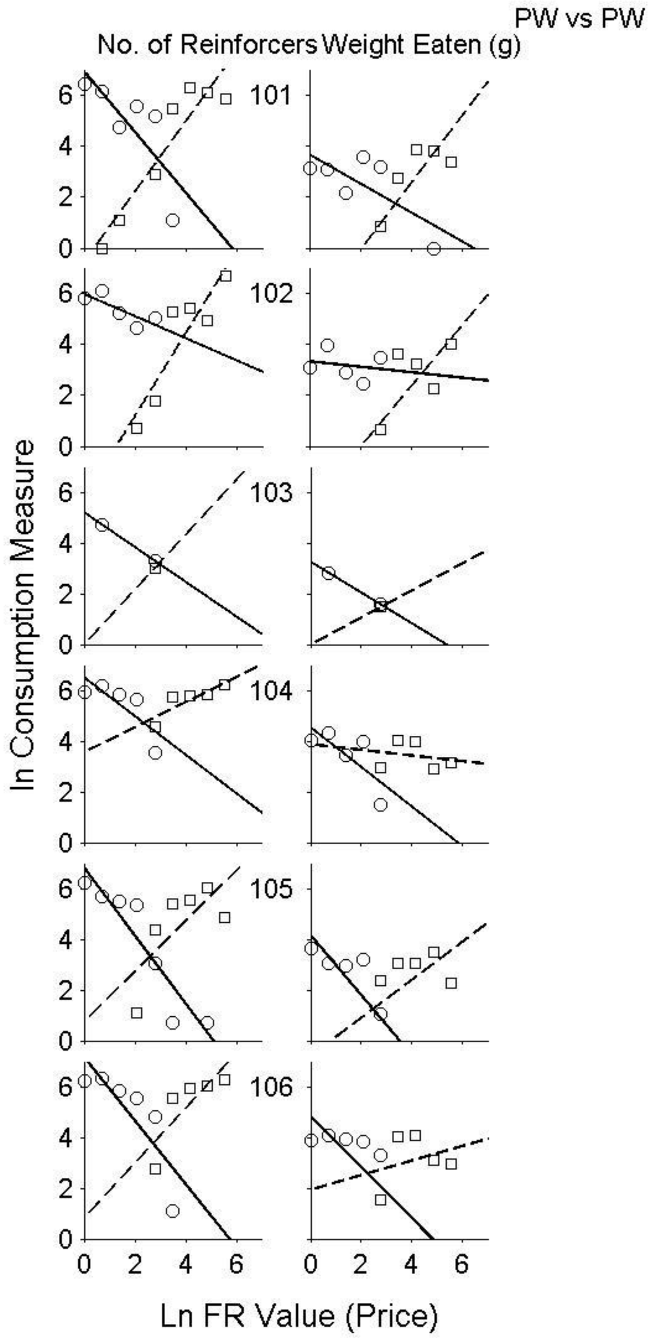


*Figure 24.* The consumption measure from the PW vs. PW. conditions

The natural logarithms of the consumption measures from the left (circles) and right (squares) magazines plotted against the natural logarithms of the FR value for the left key PW vs. PW session. The number of the reinforcers is shown in the left panel and the weight of the food eaten in the right panel. The lines were fitted by the method of least squares

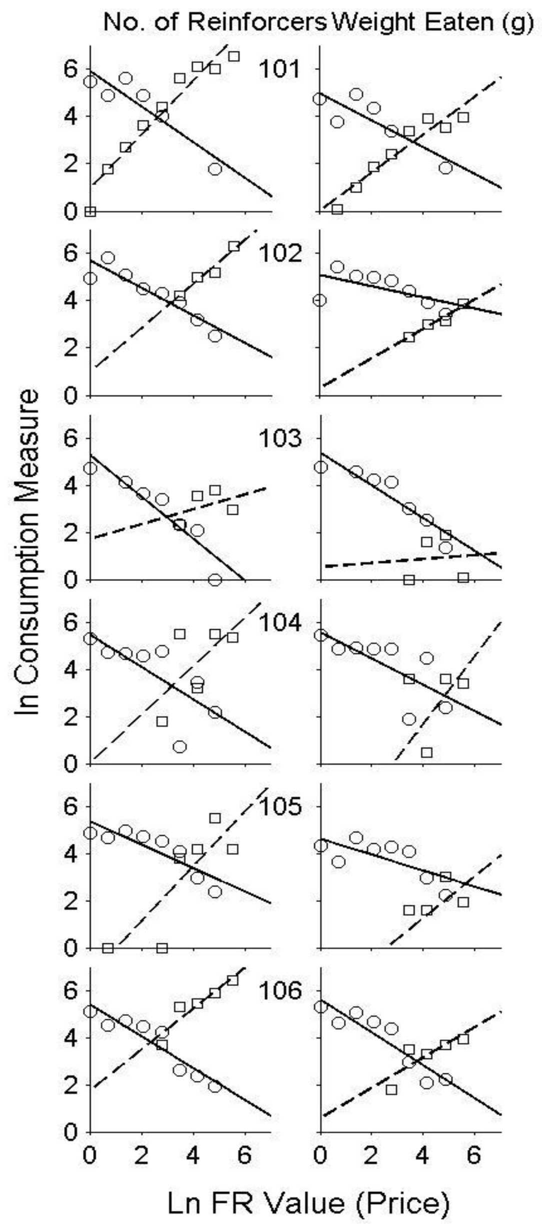


*Figure 25.* The consumption measure from the W vs. PW. conditions

The natural logarithms of the consumption measures from the left (circles) and right (squares) magazines plotted against the natural logarithms of the FR value for the left key W vs. PW session. The number of the reinforcers is shown in the left panel and the weight of the food eaten in the right panel. The lines were fitted by the method of least squares

Table 7.

*Parameters of the linear fits for Condition 1.*

The parameters *i* (intercept), *m* (slope), the standard error of the estimates of fits (*se)*, the percentages of variance accounted for *(%VAC*) and the CP (cross-point) for Condition 1 (W vs. W) for each hen are presented.

| Hen | Function 1 | | | | Function 2 | | | | Cross Point | |
|---|---|---|---|---|---|---|---|---|---|---|
| | intercept | slope | se | %VAC | intercept | slope | se | %VAC | FR | Consumption |
| **Numbers of Reinforcers** | | | | | | | | | | |
| 101 | 5.76 | -0.53 | 0.33 | 80.55 | 2.18 | 0.62 | 0.75 | 52.48 | 23 | 61 |
| 102 | 5.64 | -1.00 | 1.12 | 62.37 | -1.30 | 1.35 | 1.30 | 69.34 | 19 | 15 |
| 103 | 4.61 | -0.91 | 0.65 | 80.49 | -1.80 | 1.24 | 1.21 | 73.97 | 20 | 7 |
| 104 | 4.65 | -0.47 | 1.10 | 22.41 | 3.56 | 0.23 | 0.54 | 22.16 | 5 | 50 |
| 105 | 5.57 | -1.10 | 1.20 | 73.84 | -0.95 | 1.22 | 0.98 | 85.12 | 17 | 12 |
| 106 | 5.61 | -0.74 | 0.61 | 70.67 | -0.04 | 1.09 | 1.14 | 65.71 | 22 | 28 |
| **Weight of Reinforcers** | | | | | | | | | | |
| 101 | 3.88 | -0.17 | 0.51 | 14.57 | -2.16 | 1.36 | 1.39 | 72.74 | 53 | 25 |
| 102 | 4.02 | -0.38 | 1.36 | 13.86 | 1.22 | 0.64 | 0.89 | 51.67 | 16 | 20 |
| 103 | 4.51 | -0.64 | 0.69 | 78.46 | -0.65 | 1.05 | 0.89 | 78.90 | 21 | 13 |
| 104 | 5.15 | -0.82 | 0.98 | 77.01 | 3.54 | 0.20 | 0.55 | 17.54 | 5 | 47 |
| 105 | 4.59 | -0.82 | 1.10 | 67.99 | -1.54 | 1.11 | 0.86 | 85.96 | 24 | 7 |
| 106 | 5.46 | -0.56 | 0.47 | 69.30 | 0.92 | 0.86 | 1.16 | 53.85 | 25 | 40 |

Table 8.

*Parameters of the linear fits for Condition 2.*

The parameters *i* (intercept), *m* (slope), the standard error of the estimates of fits (*se)*, the percentages of variance accounted for *(%VAC*) and the CP (cross-point) for Condition 2 (PW vs. PW) for each hen are presented.

| Hen | Function 1 | | | | Function 2 | | | | Cross Point | |
|---|---|---|---|---|---|---|---|---|---|---|
| | intercept | slope | se | %VAC | intercept | slope | se | %VAC | FR | Consumption |
| **Number of Reinforcers** | | | | | | | | | | |
| 101 | 6.94 | -1.19 | 1.32 | 63.21 | -0.56 | 1.38 | 0.96 | 88.59 | 18 | 32 |
| 102 | 5.96 | -0.43 | 0.40 | 64.92 | -2.07 | 1.63 | 1.14 | 81.15 | 49 | 72 |
| 103 | 5.19 | -0.68 | | | 0.00 | 1.08 | | | - | - |
| 104 | 6.50 | -0.76 | 0.78 | 60.64 | 3.59 | 0.49 | 0.36 | 75.03 | 10 | 114 |
| 105 | 6.80 | -1.34 | 0.97 | 86.37 | 0.77 | 0.99 | 1.39 | 51.84 | 13 | 28 |
| 106 | 7.14 | -1.25 | 1.26 | 67.24 | 0.83 | 1.08 | 0.96 | 66.84 | 15 | 43 |
| **Weight of Reinforcers** | | | | | | | | | | |
| 101 | 3.65 | -0.57 | 0.99 | 54.72 | -2.71 | 1.32 | 0.99 | 83.33 | 29 | 6 |
| 102 | 3.33 | -0.11 | 0.66 | 4.12 | -2.41 | 1.19 | 1.27 | 64.91 | 82 | 17 |
| 103 | 3.25 | -0.61 | | | 0.00 | 0.53 | | | - | - |
| 104 | 4.54 | -0.78 | 0.87 | 56.56 | 3.88 | -0.11 | 0.62 | 4.88 | 3 | 43 |
| 105 | 4.17 | -1.18 | 1.08 | 80.10 | -0.60 | 0.75 | 1.31 | 40.86 | 12 | 4 |
| 106 | 4.82 | -1.00 | 1.36 | 53.18 | 1.94 | 0.29 | 1.14 | 9.32 | 9 | 13 |

Table 9.

*Parameters of the linear fits for Condition 1.*

The parameters *i* (intercept), *m* (slope), the standard error of the estimates of fits (*se)*, the percentages of variance accounted for *(%VAC*) and the CP (cross-point) for Condition 4 (W vs. PW) for each hen are presented.

| Hen | Function 1 | | | | Function 2 | | | | Cross Point | |
|---|---|---|---|---|---|---|---|---|---|---|
| | intercept | slope | se | %VAC | intercept | slope | se | %VAC | FR | Consumption |
| **Number of Reinforcers** | | | | | | | | | | |
| 101 | 5.92 | -0.76 | 0.62 | 84.77 | 0.91 | 1.14 | 0.60 | 93.72 | 14 | 51 |
| 102 | 5.69 | -0.58 | 0.44 | 85.69 | 0.96 | 0.93 | 0.26 | 94.01 | 23 | 48 |
| 103 | 5.27 | -0.89 | 0.62 | 87.26 | 1.72 | 0.31 | 0.73 | 18.28 | 19 | 14 |
| 104 | 5.46 | -0.69 | 1.17 | 53.40 | 0.00 | 1.03 | 1.46 | 44.18 | 24 | 27 |
| 105 | 5.36 | -0.50 | 0.50 | 76.77 | -1.22 | 1.16 | 1.38 | 72.35 | 53 | 30 |
| 106 | 5.39 | -0.67 | 0.46 | 87.62 | 1.77 | 0.87 | 0.43 | 86.76 | 11 | 45 |
| **Weight of Reinforcers** | | | | | | | | | | |
| 101 | 4.96 | -0.57 | 0.65 | 74.15 | 0.01 | 0.80 | 0.47 | 90.63 | 37 | 18 |
| 102 | 5.07 | -0.24 | 0.58 | 35.76 | 0.29 | 0.63 | 0.18 | 93.71 | 253 | 43 |
| 103 | 5.38 | -0.70 | 0.52 | 85.55 | 0.53 | 0.08 | 1.21 | 0.56 | 506 | 3 |
| 104 | 5.57 | -0.56 | 0.98 | 52.06 | -4.10 | 1.44 | 2.02 | 44.75 | 127 | 18 |
| 105 | 4.63 | -0.34 | 0.63 | 49.83 | -2.29 | 0.89 | 1.17 | 67.91 | 283 | 15 |
| 106 | 5.62 | -0.70 | 0.54 | 85.01 | 0.57 | 0.65 | 0.54 | 69.58 | 43 | 20 |

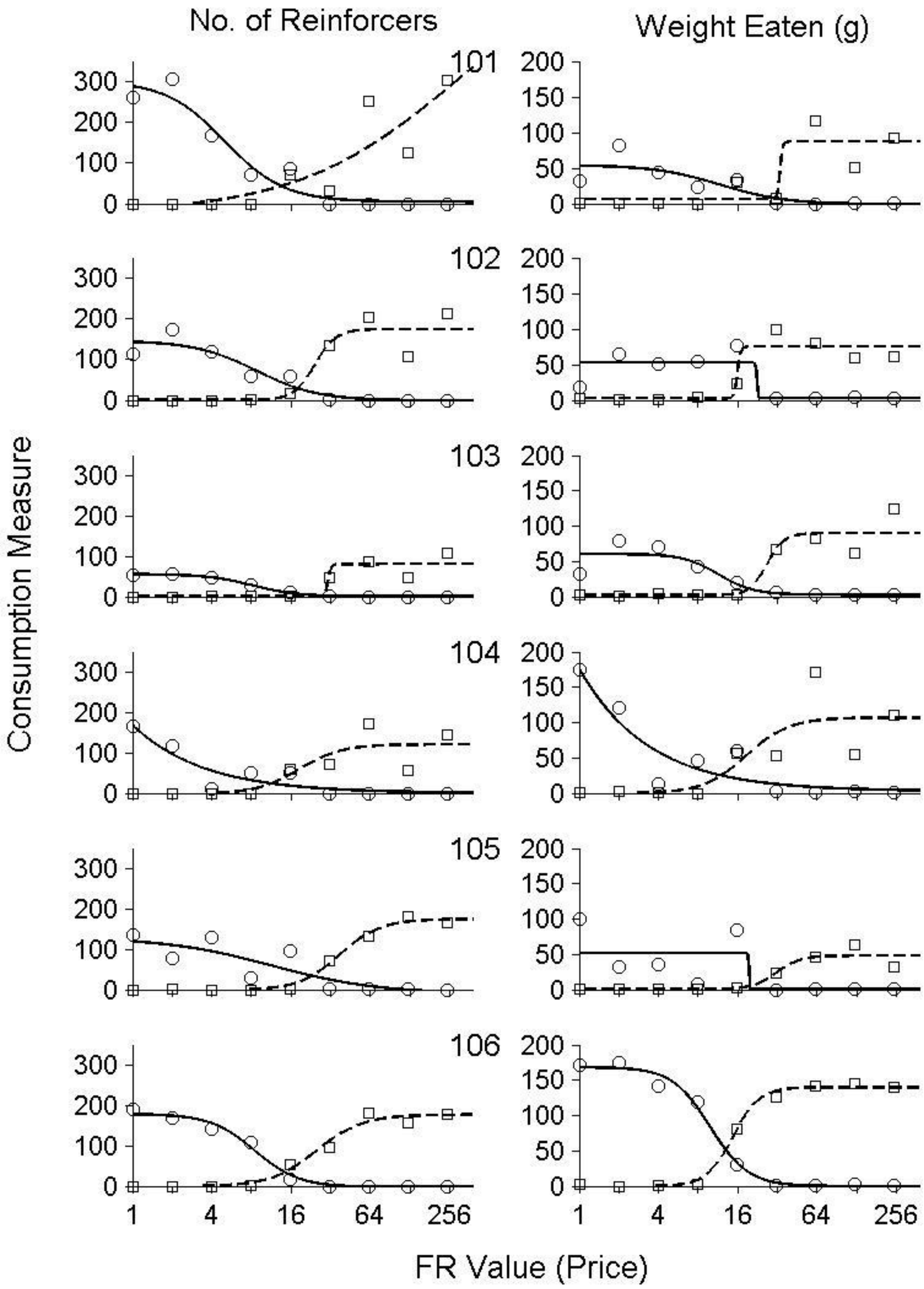


*Figure 26*. The data for the W vs. W. condition fitted with Equation 7 plotted as functions of the FR values on the left key presented on log-log co-ordinates.

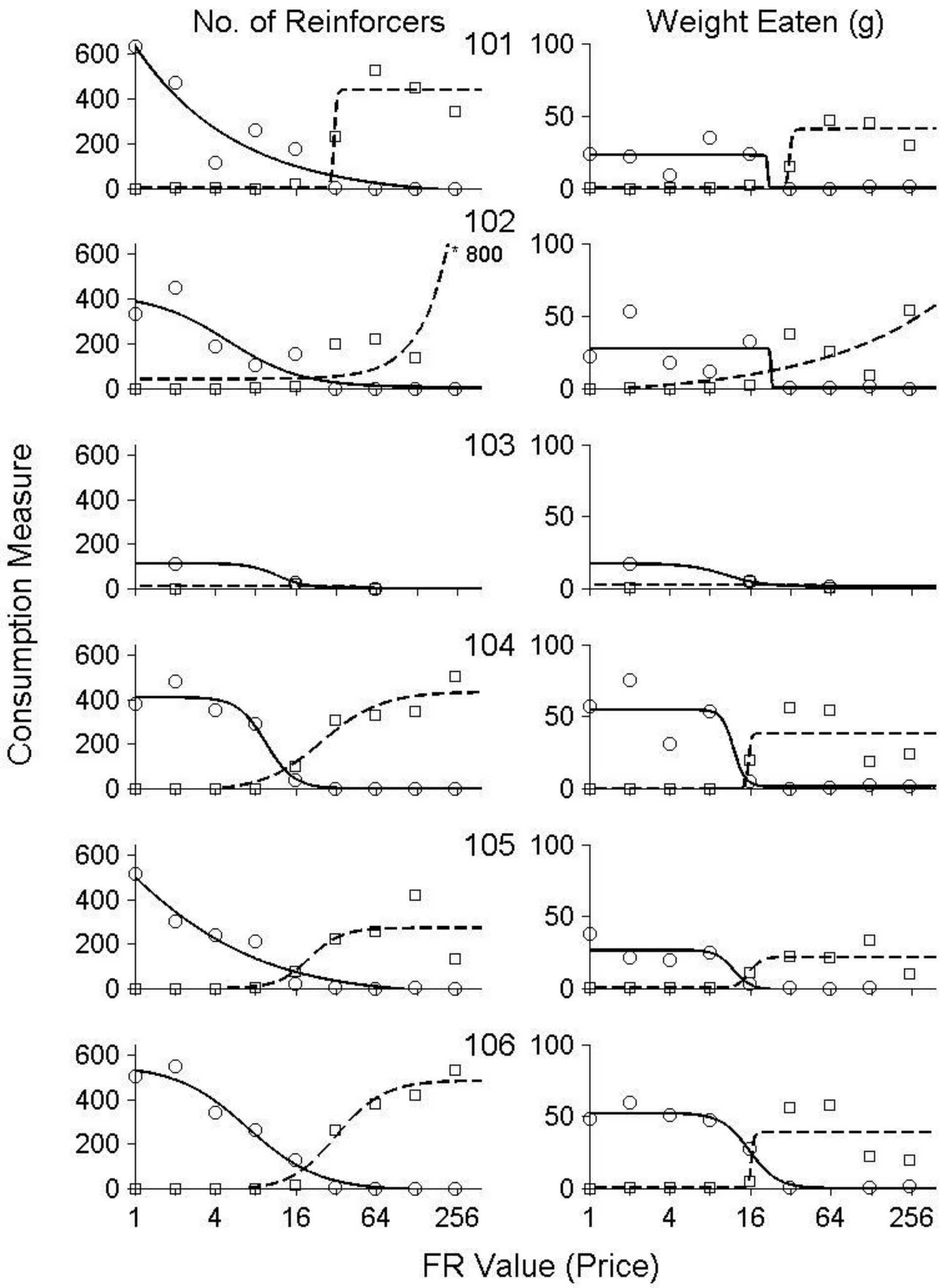


*Figure 27*. The data for the PW vs. PW. condition fitted with Equation 7 plotted as functions of the FR values on the left key presented on log-log co-ordinates

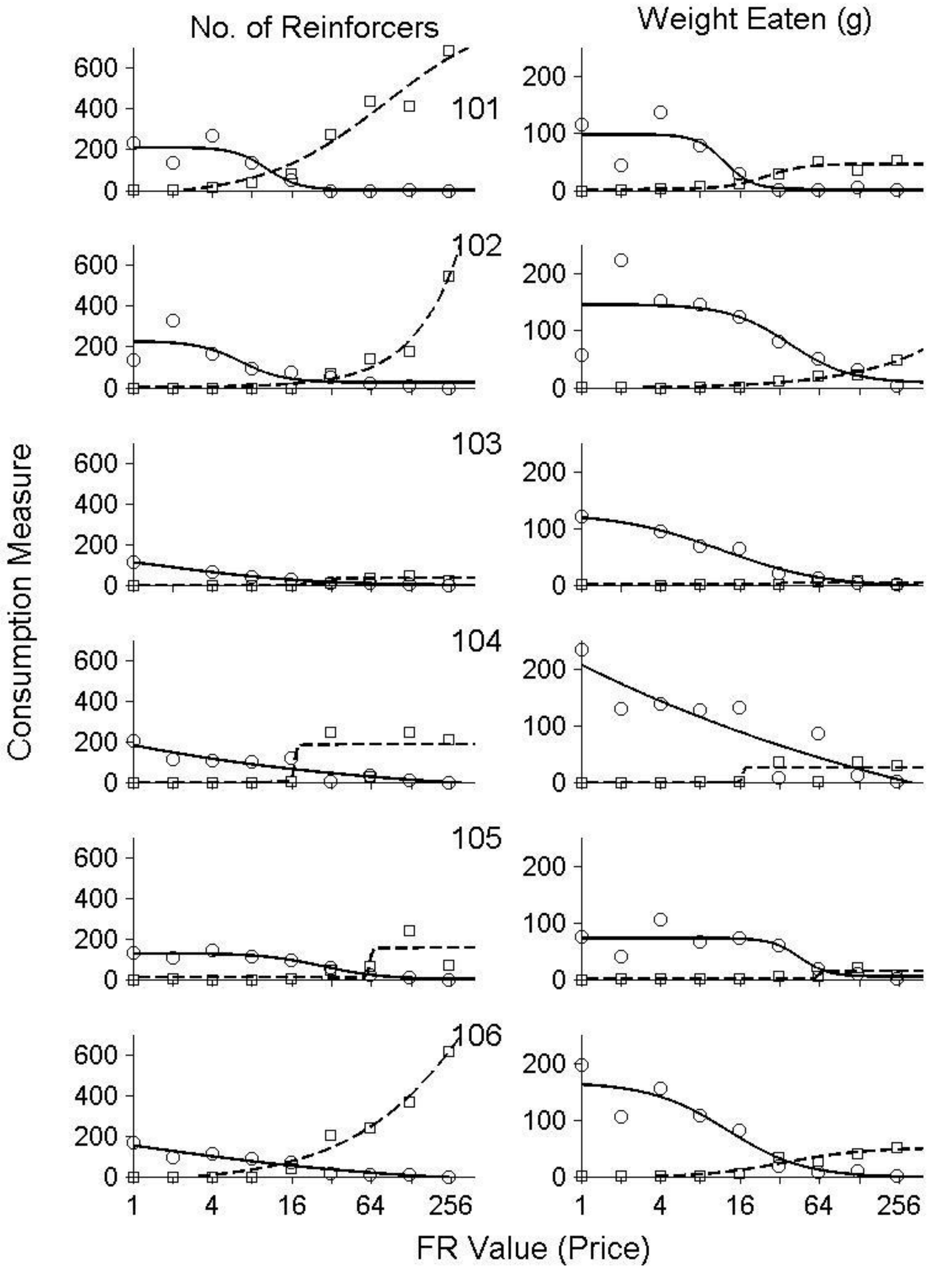


*Figure 28.* The data for the W vs. PW. condition fitted with Equation 7 plotted as functions of the FR values on the left key presented on log-log co-ordinates

Table 10.

*The parameters of the sigmoidal fits for Condition 1.*

The parameter estimates I50 (the FR values giving 50% of reinforcers between D and C), g (the slope of the nonlinear curve at the I50 point), D (the upper limit of Y), C (the lower limit of Y), se (the standard error of the estimates of the fits) and the percentage of variance accounted for fitting the data with Equation 7 for the W vs. W condition. The cross points were visually estimated.

| | | | | | | | | ***Cross Point*** | |
|---|---|---|---|---|---|---|---|---|---|
| **Hen** | **Function** | ***I50*** | ***g*** | ***C*** | ***D*** | ***se*** | ***%VAC*** | ***FR*** | ***Consumption*** |
| **Number of Reinforcers** | | | | | | | | | |
| 101 | LFR | 1.63 | 1.91 | 4.43 | 301.29 | 27.18 | 94.2 | 15 | 50 |
| 101 | RFR | 5.81 | 0.69 | -23.58 | 649.19 | 51.58 | 77.9 | | |
| 102 | LFR | 2.18 | 1.84 | -1.36 | 145.66 | 19.18 | 90.0 | 20 | 20 |
| 102 | RFR | 3.23 | 5.39 | 0.64 | 174.49 | 27.44 | 89.7 | | |
| 103 | LFR | 2.11 | 2.49 | 0.06 | 55.40 | 1.12 | 99.8 | 30 | 0 |
| 103 | RFR | 3.46 | 39.65 | 0.80 | 80.80 | 14.83 | 85.9 | | |
| 104 | LFR | -14.11 | 0.79 | -0.35 | 1.121E+07 | 21.04 | 86.3 | 12 | 20 |
| 104 | RFR | 2.94 | 2.66 | -2.14 | 120.54 | 30.91 | 74.9 | | |
| 105 | LFR | 2.46 | 1.05 | -11.01 | 129.09 | 28.26 | 72.5 | 24 | 20 |
| 105 | RFR | 3.65 | 2.78 | -1.72 | 174.33 | 6.70 | 99.2 | | |
| 106 | LFR | 2.15 | 2.55 | -2.98. | 178.43 | 8.60 | 98.7 | 14 | 20 |
| 106 | RFR | 3.25 | 2.47 | -1.05 | 176.83 | 11.24 | 97.8 | | |
| **Weight of Food** | | | | | | | | | |
| 101 | LFR | 2.5 | 1.71 | -1.84 | 54.06 | 14.22 | 70.6 | 32 | 5 |
| 101 | RFR | 3.54 | 46.81 | 6.04 | 87.23 | 17.97 | 81.8 | | |
| 102 | LFR | 3.40 | 45.87 | 0.00 | 52.76 | 14.77 | 75.5 | 16 | 50 |
| 102 | RFR | 2.79 | 39.99 | 1.15 | 75.30 | 10.85 | 91.3 | | |
| 103 | LFR | 2.48 | 3.13 | 1.33 | 60.28 | 12.41 | 81.6 | 24 | 5 |
| 103 | RFR | 3.30 | 6.16 | 1.23 | 89.88 | 14.81 | 88.6 | | |
| 104 | LFR | -20.73 | 0.80 | 1.07 | 3.01E+09 | 22.11 | 86.1 | 12 | 30 |
| 104 | RFR | 2.93 | 2.61 | -1.77 | 106.79 | 30.97 | 69.8 | | |
| 105 | LFR | 3.14 | 95.96 | 0.72 | 52.04 | 25.50 | 50.0 | 24 | 0 |
| 105 | RFR | 3.48 | 4.68 | 0.36 | 47.97 | 7.70 | 88.5 | | |
| 106 | LFR | 2.32 | 2.92 | -1.96 | 168.39 | 6.91 | 99.1 | 14 | 50 |
| 106 | RFR | 2.71 | 4.15 | -1.52 | 140.07 | 3.97 | 99.6 | | |

Table 11.

*The parameters of the sigmoidal fits for Condition 2*

The parameter estimates $I_{50}$ (the FR values giving 50% of reinforcers between D and C), g (the slope of the nonlinear curve at the $I_{50}$ point), D (the upper limit of Y), C (the lower limit of Y), se (the standard error of the estimates of the fits) and the percentage of variance accounted for fitting the data with Equation 7 for the PW vs. PW condition. The cross points were visually estimated.

| | | | | | | | | Cross Point | |
|---|---|---|---|---|---|---|---|---|---|
| **Hen** | **Function** | ***I50*** | ***g*** | ***C*** | ***D*** | ***se*** | ***%VAC*** | ***FR*** | ***Consumption*** |
| **Number of Reinforcers** | | | | | | | | | |
| 101 | LFR | -17.38 | 0.57 | -38.79 | 1.41E+07 | 69.42 | 90.0 | 32 | 75 |
| 101 | RFR | 3.46 | 41.79 | 4.40 | 442.00 | 45.26 | 95.2 | | |
| 102 | LFR | 1.61 | 1.55 | 3.38 | 420.68 | 57.42 | 86.2 | 24 | 70 |
| 102 | RFR | 14.46 | 2.02 | 41.33 | 4.94+10 | 78.55 | 89.7 | | |
| 103 | LFR | - | - | - | - | - | - | - | - |
| 103 | RFR | - | - | - | - | - | - | | |
| 104 | LFR | 2.27 | 4.10 | -2.52 | 411.03 | 31.24 | 97.3 | 14 | 70 |
| 104 | RFR | 3.25 | 1.94 | -13.56 | 435.21 | 41.40 | 95.0 | | |
| 105 | LFR | -0.84 | 0.71 | -35.14 | 1474.28 | 37.71 | 95.3 | 16 | 70 |
| 105 | RFR | 3.03 | 3.56 | -1.32 | 271.82 | 68.85 | 76.2 | | |
| 106 | LFR | 1.96 | 1.61 | -11.82. | 556.00 | 32.55 | 97.6 | 20 | 70 |
| 106 | RFR | 3.51 | 2.45 | -9.94 | 486.33 | 32.31 | 97.6 | | |
| **Weight of Food** | | | | | | | | | |
| 101 | LFR | 3.09 | 104.56 | 0.45 | 22.78 | 6.28 | 75.7 | 24 | 0 |
| 101 | RFR | 3.48 | 39.82 | 0.54 | 40.67 | 4.42 | 94.5 | | |
| 102 | LFR | 3.15 | 105.02 | 0.50 | 27.48 | 10.86 | 60.4 | 24 | 10 |
| 102 | RFR | 41.39 | 0.45 | -5.71 | 4.39E+08 | 11.60 | 62.7 | | |
| 103 | LFR | - | - | - | - | - | - | - | - |
| 103 | RFR | - | - | - | - | - | - | | |
| 104 | LFR | 2.50 | 9.78 | 0.87 | 54.48 | 10.60 | 85.9 | 16 | 5 |
| 104 | RFR | 2.77 | 42.15 | -0.10 | 38.18 | 11.53 | 71.0 | | |
| 105 | LFR | 2.51 | 6.49 | -1.30 | 26.41 | 4.89 | 88.0 | 14 | 5 |
| 105 | RFR | 2.78 | 9.77 | -1.30 | 21.58 | 5.59 | 76.5 | | |
| 106 | LFR | 2.78 | 4.10 | -0.25 | 52.17 | 3.05 | 98.4 | 16 | 20 |
| 106 | RFR | 2.82 | 43.34 | 0.25 | 39.13 | 12.05 | 71.2 | | |

Table 12.

*The parameters of the sigmoidal fits for Condition 3*

The parameter estimates $I_{50}$ (the FR values giving 50% of reinforcers between D and C), g (the slope of the nonlinear curve at the $I_{50}$ point), D (the upper limit of Y), C (the lower limit of Y), se (the standard error of the estimates of the fits) and the percentage of variance accounted for fitting the data with Equation 7 for the W vs. PW condition. The cross points were visually estimated.

| | | | | | | | | ***Cross Point*** | |
|---|---|---|---|---|---|---|---|---|---|
| **Hen** | **Function** | ***I50*** | ***g*** | ***C*** | ***D*** | ***se*** | ***%VAC*** | ***FR*** | ***Consumption*** |
| **Number of Reinforcers** | | | | | | | | | |
| 101 | LFR | 2.35 | 3.48 | 2.22 | 210.21 | 34.89 | 87.6 | 12 | 100 |
| 101 | RFR | 4.45 | 0.93 | -31.35 | 891.10 | 49.75 | 95.5 | | |
| 102 | LFR | 1.90 | 2.64 | 25.21 | 227.06 | 50.34 | 73.2 | 24 | 50 |
| 102 | RFR | 19.71 | 1.25 | 1.90 | 2.76E+10 | 25.10 | 97.8 | | |
| 103 | LFR | 0.70 | 0.79 | -4.74 | 177.71 | 2.45 | 99.5 | 30 | 20 |
| 103 | RFR | 3.49 | 36.98 | 0.00 | 32.33 | 6.29 | 85.1 | | |
| 104 | LFR | -14.11 | 0.79 | -0.35 | 3.72E+06 | 26.58 | 83.3 | 16 | 100 |
| 104 | RFR | -46.82 | 0.20 | -89.94 | 183.00 | 61.58 | 68.3 | | |
| 105 | LFR | 3.34 | 1.91 | 0.31 | 127.72 | 9.49 | 96.6 | 60 | 20 |
| 105 | RFR | 4.17 | 40.12 | 7.67 | 154.00 | 43.11 | 66.1 | | |
| 106 | LFR | -0.38 | 0.37 | -48.64. | 385.06 | 15.98 | 91.4 | 14 | 70 |
| 106 | RFR | 7.35 | 0.72 | -33.38 | 2941.90 | 28.74 | 98.0 | | |
| **Weight of Food** | | | | | | | | | |
| 101 | LFR | 2.52 | 4.05 | 1.85 | 97.76 | 23.38 | 77.9 | 18 | 10 |
| 101 | RFR | 3.24 | 2.91 | 2.06 | 46.21 | 4.96 | 93.7 | | |
| 102 | LFR | 3.66 | 1.88 | 7.81 | 145.35 | 39.84 | 63.5 | 120 | 20 |
| 102 | RFR | 27.53 | 0.74 | -1.74 | 5.05E+08 | 2.83 | 96.6 | | |
| 103 | LFR | 2.48 | 1.08 | -5.22 | 127.21 | 5.97 | 98.0 | 190 | 5 |
| 103 | RFR | 3.50 | 40.89 | 0.13 | 4.27 | 1.44 | 64.5 | | |
| 104 | LFR | -107.19 | 0.12 | -203.51 | 1.93E+08 | 33.46 | 79.1 | 128 | 40 |
| 104 | RFR | 2.85 | 62.35 | -0.03 | 25.83 | 9.5 | 64.5 | | |
| 105 | LFR | 3.84 | 4.00 | 4.84 | 72.28 | 16.11 | 76.1 | 70 | 10 |
| 105 | RFR | 4.18 | 41.74 | 0.93 | 13.45 | 3.40 | 69.4 | | |
| 106 | LFR | 2.56 | 1.47 | -2.40 | 165.95 | 22.49 | 88.8 | 40 | 25 |
| 106 | RFR | 3.57 | 1.41 | -1.88 | 50.58 | 5.10 | 93.0 | | |

**Discussion**

One aim of this experiment was to see if the cross-price demand method of evaluating comparative reinforcer value would work with two foods and with hens. The second aim was to compare the conclusions from these functions to those from the one-price demand functions generated in the first part of this study. Two reinforcers were presented to the hens simultaneously to work for across nine pairs of Conc FR FR schedules. The Conc FR FR schedules were presented based on the two alternating levers procedure described by Holm et al. (2007). This method of varying the FR schedules was selected because it was found to reduce side bias which is common when animals are responding on Conc FR FR schedules. The data obtained showed that when the hens were given the same food, they would generally respond most on the key with the lower FR value of any pair. Even with quite small differences between the two FR schedules there was frequently exclusive responding on the key associated with the smaller schedule. With the same foods available on both keys the cross points for both measures of consumption (estimated from either the linear or the sigmoidal functions) were generally around the point where there were equal schedules (FR 16 FR 16), with the exception of Hen 104. Hen 104's bias was seen most clearly in the linear fits and was to the right with both foods. Thus, the data obtained show that side biases were minimal using this procedure, with the exception of Hen 104.

The linear CP analysis that Sorensen et al (2004) used was plotted on the non-log log scales and they evaluated the value of the reinforcers based on the divergent of the CPs. The sigmoid CP from Holm et al. (2008) was plotted on the non log-log co-ordinates and the similar approach was used to evaluate the reinforcer's value. In the current study the CPs were plotted on the log-log coordinates with the same way of interpreting the CP to assess the reinforcers. The results were consistent. Thus, regardless of how the data were represented on the graphs on the cross point, the CP analysis would arrive at the same findings.

The range of FR schedules used was much larger than that one used by Holm et al. (2007). Nine pairs of FR FR schedules were used, range from FR 1 to FR256, in the current study while Holm et al. (2007) used only five pairs from FR 10 to FR 50. Because of this range the present data are presented with the Price (FR) on a logarithmic scale.

Fitting the linear functions using log-log coordinates means that the data points with zero reinforcers are not included in the analyses. These data were presented on log-log co-ordinates in this study as constant elasticity will be linear on a log-log plot, as pointed out by Hursh (1980) (see Figure 1 in the General Introduction). Sorensen et al. (2004) used non-log co-ordinates but do not present their data graphically and so it is not possible to assess the shape of their data paths. The present data appear roughly linear although there are some data sets that curve somewhat on the log-log coordinates e.g., the data for Hen 102 in Figure 23. The data are variable and although the straight lines tend to describe the data paths the variability leads to a wide range for the % VAC from the fitted functions. The values of the slope and the intercept vary widely across conditions and with the measures of consumption (the number of reinforcers and the weight of food eaten). Despite this variability, the CPs from the linear functions was interpretable. For Condition 1, when both reinforcers were W, the CPs were around FR 16 to FR 23; when the number of reinforcers was measured. With the weight of food eaten the CPs were around FR 16 to FR 53.For Condition 2 when both reinforcers were PW, the CPs ranges from FR 10 to FR 50 when the number of reinforcers was measured and from FR 3 to FR 83 when the weight of food was measured. For Condition 3 when W and PW were the reinforcers, the CPs ranges from FR 14 to FR 53 when the number of reinforcers was measured and from FR 37 to FR 505 when the weight of food was measured. The value of the CPs of Condition 3 were larger than the mid FR range, that is they shifted to larger values suggesting that W is the more value reinforcers.

With the sigmoidal functions, the data were better described with reasonably high % VAC. However, this is not surprising as this function has four free parameters. In addition, using the non-log consumption measure allowed the zero consumption data to be included in the analyses.

The CPs showed greatest divergence from the middle value for W vs. PW when the weight of food consumed was the measure of consumption for all but Hen 101. This finding was similar to those obtained from the linear fits, that is W is a more value reinforce.

Comparing the data from the cross-price demand assessment with the own-price demand assessment showed that four hens (Hens 102, 103, 105 and 106) gained more W at FR 1 when the number of reinforcers was the consumption measure. Hens 102, 103 received more PW in Experiment 1. Hen 106 received almost equal amount of PW in both Experiments 1 and 2. As for the weight of food consumed five hens received more W in Experiment 1. Hen 106 is the exception. Three hens received more PW at FR 1 during the own-price demand assessment. The CP of the W vs. PW session of Experiment 2 for Hen 101 had shifted to a small FR suggesting that Hen 101 prefers PW more. The result of Experiment 1 with Hursh and Winger (1995) and Hursh and Silberberg (2008) model of demand analysis showed that $P_{max}$ for Hen 101 was higher for PW. This may suggest that Hen 101 likes PW more than W. The study of Flevill (2002) showed that hens preferred W, however Hen 101 maybe one of the exceptions.

## GENERAL DISCUSSION

The own-price demand approach of evaluating the reinforcers uses various parameters such as the elasticity (*a*), the value of the initial slope (*b*), initial consumption (*Ln L*) at lowest FR (FR 1) (Hursh et al, 1988) and the $P_{max}$ of the normalized demand function (Hursh & Winger, 1995) to determine the value of reinforcers. Hursh and Silberberg (2008) claimed that the single value α could be used to assess the value of a reinforcer. As shown in Experiment 1 the comparison of single demand functions is not straightforward and can be confounded by the types of consumption measures used.

The cross-price demand with the CP analysis is a simpler approach to compare the values of reinforcers. Despite of the wide variation found across the parameter values of both linear and sigmoidal functions used for fitting to the data, the CP result were consistent, showing a greater divergent of CP( i.e. the CP shifted to the larger FR for weight consumed).

The findings of the two experiments show both approaches indicate wheat is higher valued when weight consumed is the measure of consumption With the number of reinforcers obtained, the results from the own-price demand were confusing with Pmax for W is higher but higher Ln L for PW. Therefore, the study showed that the cross-price demand approach is a reliable measure for reinforcer value and is a better approach due to the simplicity to interpret.

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# APPENDIX A.

This appendix presents the raw data from the own price demand assessments for Condition 1 (wheat) and Condition 2 (puffed wheat) of Run 2 and Run 3 for each hen for Experiment 1. The hen number (Hen), the date (Yr, Day, Mth), the Condition number (Cond), the runs (Run), the FR schedule (FR), the latency to the first peck (First), the total number of responses (Rsp), the number of reinforcers obtained (Rfts), the post-reinforcement pause durations (PRP), the runtime (RunT), the keytime (KeyT), the total session time (TotT), eat time (EatT) and the amount of food eaten (WRE) are presented. All units are indicated in seconds except for WRE, which was in grams.

| Hen | Yr | day | Mth | Cond | Run | FR | First | Rsp | Rfts | PRP | RunT | KeyT | TotT | EatT | WRE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 9 | 29 | 5 | 1 | 1 | 1 | 8.1 | 122 | 122 | 2379.2 | 5.7 | 2400.1 | 2766.1 | 76 | 35.6 |
| 101 | 9 | 3 | 6 | 1 | 1 | 2 | 0 | 418 | 209 | 2282.5 | 107 | 2400.1 | 3027.1 | 564 | 126.5 |
| 101 | 9 | 9 | 6 | 1 | 1 | 4 | 0.5 | 551 | 137 | 245.2 | 2146.5 | 2400.1 | 2811.1 | 397 | 73.8 |
| 101 | 9 | 11 | 6 | 1 | 1 | 8 | 0.6 | 1480 | 185 | 1113 | 1275.6 | 2400.1 | 2955.1 | 423 | 97.2 |
| 101 | 9 | 18 | 6 | 1 | 1 | 16 | 0.6 | 1952 | 122 | 1421.8 | 971.3 | 2400.1 | 2766.1 | 575 | 114.6 |
| 101 | 9 | 19 | 6 | 1 | 1 | 32 | 0.6 | 1568 | 49 | 1417.8 | 979.3 | 2400.1 | 2547.1 | 148 | 32 |
| 101 | 9 | 22 | 6 | 1 | 1 | 64 | 0.4 | 2463 | 38 | 320.6 | 2076.7 | 2400.1 | 2514.1 | 279 | 65.8 |
| 101 | 9 | 23 | 6 | 1 | 1 | 128 | 0.5 | 2112 | 16 | 100.5 | 2298 | 2400.1 | 2448.1 | 68 | 17.6 |
| 101 | 9 | 24 | 6 | 1 | 1 | 256 | 0.8 | 1782 | 6 | 73 | 2325.9 | 2400.1 | 2418.1 | 20 | 8 |
| 101 | 9 | 26 | 6 | 1 | 1 | 512 | 1.2 | 740 | 1 | 7.2 | 2391.6 | 2400.1 | 2403.1 | 5 | 2.7 |
| | | | | | | | | | | | | | | | |
| 102 | 9 | 27 | 5 | 1 | 1 | 1 | 5.6 | 190 | 190 | 2374.9 | 9.1 | 2400.1 | 2970.1 | 587 | 126 |
| 102 | 9 | 29 | 5 | 1 | 1 | 2 | 0.5 | 632 | 316 | 1691.4 | 691.4 | 2400.1 | 3348.1 | 1627 | 234.9 |
| 102 | 9 | 3 | 6 | 1 | 1 | 4 | 0.5 | 459 | 114 | 679.2 | 1714.5 | 2400.1 | 2742.1 | 1008 | 221.9 |
| 102 | 9 | 5 | 6 | 1 | 1 | 8 | 0.9 | 280 | 35 | 2189.6 | 207.9 | 2400.1 | 2505.1 | 242 | 54.7 |
| 102 | 9 | 9 | 6 | 1 | 1 | 16 | 9.6 | 978 | 61 | 1009.5 | 1377.6 | 2400.1 | 2583.1 | 565 | 120.5 |
| 102 | 9 | 11 | 6 | 1 | 1 | 32 | 1.9 | 1344 | 42 | 879.9 | 1515.8 | 2400.1 | 2526.1 | 346 | 86.7 |
| 102 | 9 | 17 | 6 | 1 | 1 | 64 | 0.7 | 1029 | 16 | 106 | 2292.3 | 2400.1 | 2448.1 | 193 | 45.3 |
| 102 | 9 | 18 | 6 | 1 | 1 | 128 | 0 | 732 | 5 | 27.4 | 2372.6 | 2400.1 | 2415.1 | 57 | 15 |
| 102 | 9 | 19 | 6 | 1 | 1 | 256 | 2.6 | 674 | 2 | 12.7 | 2384.7 | 2400.1 | 2406.1 | 21 | 5.6 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 103 | 9 | 27 | 5 | 1 | 1 | 1 | 108 | 114 | 114 | 2279.8 | 5.4 | 2400.1 | 2742.1 | 716 | 126.7 |
| 103 | 9 | 29 | 5 | 1 | 1 | 2 | 79 | 220 | 110 | 1423.1 | 892.9 | 2400.1 | 2730.1 | 423 | 107.6 |
| 103 | 9 | 3 | 6 | 1 | 1 | 4 | 0.9 | 448 | 112 | 1098.3 | 1294.3 | 2400.1 | 2736.1 | 861 | 159.9 |
| 103 | 9 | 5 | 6 | 1 | 1 | 8 | 8.5 | 125 | 15 | 236.6 | 2154.2 | 2400.1 | 2445.1 | 70 | 13.7 |
| 103 | 9 | 9 | 6 | 1 | 1 | 16 | 4.6 | 433 | 27 | 1623.4 | 770.1 | 2400.1 | 2481.1 | 206 | 50.6 |
| 103 | 9 | 11 | 6 | 1 | 1 | 32 | 1.2 | 1001 | 31 | 582.9 | 1814.6 | 2400.1 | 2493.1 | 219 | 50.8 |
| 103 | 9 | 17 | 6 | 1 | 1 | 64 | 0.9 | 739 | 11 | 144.1 | 2254.6 | 2400.1 | 2433.1 | 86 | 21.6 |
| 103 | 9 | 18 | 6 | 1 | 1 | 128 | 1.4 | 524 | 4 | 88.4 | 2310.2 | 2400.1 | 2412.1 | 24 | 5.7 |
| | | | | | | | | | | | | | | | |
| 104 | 9 | 1 | 6 | 1 | 1 | 1 | 0.9 | 256 | 256 | 2372.5 | 12.3 | 2400.1 | 3168.1 | 1158 | 93.5 |
| 104 | 9 | 4 | 6 | 1 | 1 | 2 | 0.5 | 484 | 242 | 1683.3 | 703.7 | 2400.1 | 3126.1 | 1329 | 140.4 |
| 104 | 9 | 8 | 6 | 1 | 1 | 4 | 0.8 | 850 | 212 | 1492 | 896.2 | 2400.1 | 3036.1 | 913 | 249.4 |
| 104 | 9 | 15 | 6 | 1 | 1 | 8 | 1.5 | 1029 | 128 | 1647 | 743.7 | 2400.1 | 2784.1 | 725 | 256 |
| 104 | 9 | 17 | 6 | 1 | 1 | 16 | 0 | 1040 | 65 | 1562.3 | 834.4 | 2400.1 | 2595.1 | 389 | 76.2 |
| 104 | 9 | 18 | 6 | 1 | 1 | 32 | 1.2 | 1184 | 37 | 1100.3 | 1296.6 | 2400.1 | 2511.1 | 223 | 45.7 |
| 104 | 9 | 19 | 6 | 1 | 1 | 64 | 0.7 | 2185 | 34 | 329.2 | 2068.3 | 2400.1 | 2502.1 | 252 | 2280 |
| 104 | 9 | 22 | 6 | 1 | 1 | 128 | 0 | 1998 | 15 | 128.9 | 2270.4 | 2400.1 | 2445.1 | 115 | 32.2 |
| 104 | 9 | 23 | 6 | 1 | 1 | 256 | 0.6 | 903 | 3 | 22.4 | 2376.9 | 2400.1 | 2409.1 | 20 | 5.4 |
| | | | | | | | | | | | | | | | |
| 105 | 9 | 1 | 6 | 1 | 1 | 1 | 1.2 | 630 | 630 | 2332.5 | 33.3 | 2400.1 | 4290.1 | 1147 | 86.5 |
| 105 | 9 | 4 | 6 | 1 | 1 | 2 | 1.3 | 245 | 122 | 1332.1 | 1060.8 | 2400.1 | 2766.1 | 510 | 110.5 |
| 105 | 9 | 8 | 6 | 1 | 1 | 4 | 1 | 668 | 167 | 1810.9 | 578.6 | 2400.1 | 2901.1 | 565 | 148.9 |
| 105 | 9 | 10 | 6 | 1 | 1 | 8 | 2 | 187 | 23 | 1906.8 | 489.6 | 2400.1 | 2469.1 | 50 | 13.2 |
| 105 | 9 | 15 | 6 | 1 | 1 | 16 | 2.2 | 1857 | 116 | 880.1 | 1511.2 | 2400.1 | 2748.1 | 555 | 120.3 |
| 105 | 9 | 17 | 6 | 1 | 1 | 32 | 1.1 | 2038 | 63 | 731.2 | 1664.7 | 2400.1 | 2589.1 | 358 | 76.1 |
| 105 | 9 | 19 | 6 | 1 | 1 | 64 | 0.6 | 2115 | 33 | 562.3 | 1835.2 | 2400.1 | 2499.1 | 175 | 44.8 |
| 105 | 9 | 22 | 6 | 1 | 1 | 128 | 0.9 | 2014 | 15 | 243.8 | 2154.3 | 2400.1 | 2445.1 | 64 | 19.9 |
| 105 | 9 | 23 | 6 | 1 | 1 | 256 | 1.6 | 1548 | 6 | 70.8 | 2327.4 | 2400.1 | 2418.1 | 30 | 9.6 |
| 105 | 9 | 24 | 6 | 1 | 1 | 512 | 1 | 1508 | 2 | 28.8 | 2370.3 | 2400.1 | 2406.1 | 11 | 3.6 |
| | | | | | | | | | | | | | | | |
| 106 | 9 | 28 | 5 | 1 | 1 | 1 | 3.6 | 264 | 264 | 2369 | 11.4 | 2400.1 | 3192.1 | 1087 | 95.1 |
| 106 | 9 | 1 | 6 | 1 | 1 | 2 | 0.7 | 1104 | 552 | 1761.6 | 606.4 | 2400.1 | 4056.1 | 2372 | 13.9 |
| 106 | 9 | 4 | 6 | 1 | 1 | 4 | 1 | 783 | 195 | 1020.9 | 1368.3 | 2400.1 | 2985.1 | 897 | 110.5 |
| 106 | 9 | 8 | 6 | 1 | 1 | 8 | 0.5 | 1200 | 150 | 1305.4 | 1086 | 2400.1 | 2850.1 | 805 | 210.5 |
| 106 | 9 | 10 | 6 | 1 | 1 | 16 | 0.7 | 1662 | 103 | 904 | 1489.1 | 2400.1 | 2709.1 | 536 | 136 |
| 106 | 9 | 15 | 6 | 1 | 1 | 32 | 0.3 | 1401 | 43 | 558.2 | 1839.3 | 2400.1 | 2529.1 | 291 | 102.8 |
| 106 | 9 | 17 | 6 | 1 | 1 | 64 | 1 | 2052 | 32 | 342.6 | 2054.5 | 2400.1 | 2496.1 | 226 | 63.2 |
| 106 | 9 | 19 | 6 | 1 | 1 | 128 | 0.6 | 1863 | 14 | 172 | 2226.8 | 2400.1 | 2442.1 | 91 | 34.3 |
| 106 | 9 | 22 | 6 | 1 | 1 | 256 | 3.4 | 751 | 2 | 20.8 | 2375.7 | 2400.1 | 2406.1 | 14 | 4.3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 9 | 14 | 9 | 2 | 1 | 1 | 0.5 | 493 | 493 | 2348 | 23.4 | 2400.1 | 3879.1 | 2135 | 75.9 |
| 101 | 9 | 16 | 9 | 2 | 1 | 2 | 0.3 | 1117 | 558 | 1785.5 | 582.5 | 2400.1 | 4074.1 | 2892 | 84.2 |
| 101 | 9 | 18 | 9 | 2 | 1 | 4 | 0.5 | 1596 | 399 | 1440.3 | 937.3 | 2400.1 | 3597.1 | 2048 | 37.6 |
| 101 | 9 | 19 | 9 | 2 | 1 | 8 | 0.5 | 2174 | 271 | 1255 | 1130.1 | 2400.1 | 3213.1 | 1461 | 51.7 |
| 101 | 9 | 21 | 9 | 2 | 1 | 16 | 1 | 2594 | 162 | 671.9 | 1719 | 2400.1 | 2886.1 | 795 | 29.1 |
| 101 | 9 | 22 | 9 | 2 | 1 | 32 | 0.5 | 2125 | 66 | 794.5 | 1601.4 | 2400.1 | 2598.1 | 446 | 12.9 |
| 101 | 9 | 23 | 9 | 2 | 1 | 64 | 0.4 | 1792 | 28 | 525.8 | 1872.5 | 2400.1 | 2484.1 | 202 | 7.5 |
| 101 | 9 | 24 | 9 | 2 | 1 | 128 | 1.7 | 885 | 6 | 33.2 | 2364.8 | 2400.1 | 2418.1 | 29 | 5.9 |
| 101 | 9 | 25 | 9 | 2 | 1 | 256 | 0.6 | 1143 | 4 | 195.4 | 2203.7 | 2400.1 | 2412.1 | 24 | 1.8 |
| 101 | 9 | 26 | 9 | 2 | 1 | 512 | 2.3 | 793 | 1 | 3.9 | 2393.9 | 2400.1 | 2403.1 | 4 | 1.8 |
| | | | | | | | | | | | | | | | |
| 102 | 9 | 6 | 10 | 2 | 1 | 1 | 0.7 | 439 | 439 | 2352.9 | 21.3 | 2400.1 | 3717.1 | 2235 | 22.4 |
| 102 | 9 | 8 | 10 | 2 | 1 | 2 | 0.4 | 470 | 235 | 2251 | 134.9 | 2400.1 | 3105.1 | 1017 | 27 |
| 102 | 9 | 12 | 10 | 2 | 1 | 4 | 1.2 | 1240 | 310 | 1738.1 | 643.3 | 2400.1 | 3330.1 | 2058 | 43.5 |
| 102 | 9 | 14 | 10 | 2 | 1 | 8 | 1.8 | 1777 | 222 | 1024.2 | 1362.9 | 2400.1 | 3066.1 | 1895 | 42.6 |
| 102 | 9 | 17 | 10 | 2 | 1 | 16 | 3.8 | 1536 | 96 | 1262.1 | 1128.3 | 2400.1 | 2688.1 | 960 | 20.6 |
| 102 | 9 | 18 | 10 | 2 | 1 | 32 | 0.9 | 676 | 21 | 1142.2 | 1256 | 2400.1 | 2463.1 | 201 | 4.4 |
| 102 | 9 | 19 | 10 | 2 | 1 | 64 | 1.4 | 647 | 10 | 842.7 | 1555.5 | 2400.1 | 2430.1 | 101 | 2.1 |
| 102 | 9 | 20 | 10 | 2 | 1 | 128 | 0.4 | 878 | 6 | 110.5 | 2288.8 | 2400.1 | 2418.1 | 67 | 1.2 |
| | | | | | | | | | | | | | | | |
| 103 | 9 | 11 | 9 | 2 | 1 | 1 | 1 | 393 | 393 | 2357.1 | 20.5 | 2400.1 | 3579.1 | 1518 | 31.8 |
| 103 | 9 | 14 | 9 | 2 | 1 | 2 | 1.4 | 688 | 344 | 1631.2 | 748.2 | 2400.1 | 3432.1 | 1852 | 60.6 |
| 103 | 9 | 18 | 9 | 1 | 1 | 4 | 2.2 | 948 | 237 | 1641.4 | 743.7 | 2400.1 | 3111.1 | 1487 | 48.9 |
| 103 | 9 | 19 | 9 | 1 | 1 | 8 | 1.2 | 827 | 103 | 1454.5 | 938.9 | 2400.1 | 2709.1 | 764 | 22.7 |
| 103 | 9 | 21 | 9 | 2 | 1 | 16 | 0.8 | 865 | 54 | 599.1 | 1797.2 | 2400.1 | 2562.1 | 468 | 13.8 |
| 103 | 9 | 22 | 9 | 2 | 1 | 32 | 3.4 | 506 | 15 | 1106.1 | 1289.8 | 2400.1 | 2445.1 | 109 | 3.6 |
| 103 | 9 | 23 | 9 | 2 | 1 | 64 | 6.8 | 640 | 10 | 428.1 | 1964.7 | 2400.1 | 2430.1 | 68 | 2.4 |
| 103 | 9 | 24 | 9 | 2 | 1 | 128 | 1.2 | 561 | 4 | 336.2 | 2062.4 | 2400.1 | 2412.1 | 19 | 1.5 |
| 103 | 9 | 25 | 9 | 2 | 1 | 256 | 4.2 | 273 | 1 | 31.1 | 2364.8 | 2400.1 | 2403.1 | 6 | -0.1 |
| | | | | | | | | | | | | | | | |
| 104 | 9 | 10 | 9 | 2 | 1 | 1 | 0.7 | 525 | 525 | 2343.4 | 26.7 | 2400.1 | 3975.1 | 2844 | 21.9 |
| 104 | 9 | 15 | 9 | 2 | 1 | 2 | 1.3 | 696 | 348 | 2166.6 | 211.7 | 2400.1 | 3444.1 | 2250 | 65.5 |
| 104 | 9 | 17 | 9 | 2 | 1 | 4 | 1 | 1808 | 452 | 1734.4 | 638.6 | 2400.1 | 3756.1 | 3061 | -13.7 |
| 104 | 9 | 19 | 9 | 2 | 1 | 8 | 0.6 | 2440 | 305 | 1309.1 | 1073 | 2400.1 | 3315.1 | 1850 | 62.3 |
| 104 | 9 | 21 | 9 | 2 | 1 | 16 | 0.5 | 3200 | 200 | 1107.2 | 1280.7 | 2400.1 | 3000.1 | 1638 | 50.9 |
| 104 | 9 | 22 | 9 | 2 | 1 | 32 | 0.7 | 2048 | 64 | 1156.7 | 1239.4 | 2400.1 | 2592.1 | 531 | 15.5 |
| 104 | 9 | 23 | 9 | 2 | 1 | 64 | 2.9 | 1536 | 24 | 866 | 1529.7 | 2400.1 | 2472.1 | 181 | 6.3 |
| 104 | 9 | 24 | 9 | 2 | 1 | 128 | 0.7 | 1110 | 8 | 455.2 | 1943.9 | 2400.1 | 2424.1 | 62 | 2.2 |
| 104 | 9 | 25 | 9 | 2 | 1 | 256 | 4.1 | 268 | 1 | 28.7 | 2367.3 | 2400.1 | 2403.1 | 5 | 0.1 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 105 | 9 | 10 | 9 | 2 | 1 | 1 | 0.5 | 442 | 442 | 2353.4 | 22.6 | 2400.1 | 3726.1 | 2024 | 21.5 |
| 105 | 9 | 15 | 9 | 2 | 1 | 2 | 0.5 | 584 | 292 | 1374.4 | 1008.4 | 2400.1 | 3276.1 | 1390 | 53.4 |
| 105 | 9 | 17 | 9 | 1 | 1 | 4 | 0.6 | 764 | 191 | 2073.7 | 315.5 | 2400.1 | 2973.1 | 886 | 34.2 |
| 105 | 9 | 19 | 9 | 1 | 1 | 8 | 5.1 | 576 | 72 | 2102.1 | 288.9 | 2400.1 | 2616.1 | 269 | 11.5 |
| 105 | 9 | 21 | 9 | 2 | 1 | 16 | 0.6 | 1692 | 105 | 1156.6 | 1236.7 | 2400.1 | 2715.1 | 382 | 17.2 |
| 105 | 9 | 22 | 9 | 2 | 1 | 32 | 0.7 | 2724 | 85 | 740.8 | 1654 | 2400.1 | 2655.1 | 448 | 17.4 |
| 105 | 9 | 23 | 9 | 2 | 1 | 64 | 0.6 | 1952 | 30 | 513 | 1884.6 | 2400.1 | 2490.1 | 167 | 6.7 |
| 105 | 9 | 24 | 9 | 2 | 1 | 128 | 0.7 | 2179 | 17 | 412.4 | 1986.2 | 2400.1 | 2451.1 | 82 | 3.1 |
| 105 | 9 | 25 | 9 | 2 | 1 | 256 | 7.2 | 1286 | 5 | 140.8 | 2251.8 | 2400.1 | 2415.1 | 23 | 1 |
| 105 | 9 | 26 | 9 | 2 | 1 | 512 | 0.3 | 734 | 1 | 35.3 | 2364.4 | 2400.1 | 2403.1 | 5 | 0.3 |
| 105 | 9 | 29 | 9 | 2 | 1 | 1024 | 0.4 | 1460 | 1 | 13.4 | 2386.3 | 2400.1 | 2403.1 | 5 | 0.3 |
| | | | | | | | | | | | | | | | |
| 106 | 9 | 8 | 9 | 2 | 1 | 20 | 0.7 | 2680 | 134 | 1110.3 | 1281 | 2400.1 | 2802.1 | 879 | 23.3 |
| 106 | 9 | 10 | 9 | 2 | 1 | 1 | 4.1 | 503 | 503 | 2343.5 | 25.1 | 2400.1 | 3909.1 | 2322 | 20.7 |
| 106 | 9 | 15 | 9 | 2 | 1 | 2 | 0.5 | 908 | 454 | 2146.1 | 227.3 | 2400.1 | 3762.1 | 1523 | 57.3 |
| 106 | 9 | 17 | 9 | 1 | 1 | 4 | 1.3 | 1376 | 344 | 1814.8 | 565.2 | 2400.1 | 3432.1 | 1841 | -35.4 |
| 106 | 9 | 19 | 9 | 1 | 1 | 8 | 1.3 | 2048 | 256 | 1478.5 | 904.5 | 2400.1 | 3168.1 | 1433 | 51.5 |
| 106 | 9 | 21 | 9 | 2 | 1 | 16 | 0.9 | 2516 | 157 | 1170.1 | 1219.8 | 2400.1 | 2871.1 | 1213 | 40.8 |
| 106 | 9 | 23 | 9 | 2 | 1 | 64 | 1 | 1293 | 20 | 905 | 1492.9 | 2400.1 | 2460.1 | 103 | 4.8 |
| 106 | 9 | 24 | 9 | 2 | 1 | 128 | 0.8 | 912 | 7 | 402.9 | 1996.3 | 2400.1 | 2421.1 | 31 | 1.8 |
| 106 | 9 | 25 | 9 | 2 | 1 | 256 | 0.6 | 477 | 1 | 54.7 | 2344.8 | 2400.1 | 2403.1 | 2 | 0.2 |
| | | | | | | | | | | | | | | | |
| 101 | 9 | 9 | 7 | 1 | 2 | 1 | 0.5 | 248 | 248 | 2373.4 | 13.2 | 2400.1 | 3144.1 | 334 | 248.66 |
| 101 | 9 | 17 | 7 | 1 | 2 | 2 | 0.4 | 445 | 222 | 2065.7 | 320.6 | 2400.1 | 3066.1 | 449 | 152 |
| 101 | 9 | 20 | 7 | 1 | 2 | 4 | 5.4 | 847 | 211 | 1523.2 | 861.6 | 2400.1 | 3033.1 | 266 | 137.6 |
| 101 | 9 | 21 | 7 | 1 | 2 | 8 | 0.4 | 416 | 52 | 1917.6 | 479.6 | 2400.1 | 2556.1 | 103 | 32.6 |
| 101 | 9 | 23 | 7 | 1 | 2 | 16 | 0.4 | 1462 | 91 | 881.6 | 1513.2 | 2400.1 | 2673.1 | 312 | 70.8 |
| 101 | 9 | 24 | 7 | 1 | 2 | 32 | 0.5 | 1377 | 43 | 612.1 | 1784.9 | 2400.1 | 2529.1 | 101 | 30.3 |
| 101 | 9 | 27 | 7 | 1 | 2 | 64 | 7.9 | 1986 | 31 | 649.6 | 1740.6 | 2400.1 | 2493.1 | 180 | 49.4 |
| 101 | 9 | 28 | 7 | 1 | 2 | 128 | 0.6 | 1429 | 11 | 181.7 | 2217 | 2400.1 | 2433.1 | 58 | 18.1 |
| 101 | 9 | 30 | 7 | 1 | 2 | 256 | 1.2 | 676 | 2 | 14.2 | 2384.5 | 2400.1 | 2406.1 | 5 | 1.9 |
| 101 | 9 | 31 | 7 | 1 | 2 | 512 | 0.3 | 1293 | 2 | 8.4 | 2391.4 | 2400.1 | 2406.1 | 11 | 3.3 |
| | | | | | | | | | | | | | | | |
| 102 | 9 | 9 | 7 | 1 | 2 | 1 | 0.7 | 133 | 133 | 2385.8 | 6.5 | 2400.1 | 2799.1 | 328 | 69 |
| 102 | 9 | 17 | 7 | 1 | 2 | 2 | 0.5 | 346 | 173 | 2231.2 | 158 | 2400.1 | 2919.1 | 606 | 125.3 |
| 102 | 9 | 20 | 7 | 1 | 2 | 4 | 6.9 | 616 | 154 | 1144.3 | 1240.3 | 2400.1 | 2862.1 | 1356 | 183.5 |
| 102 | 9 | 21 | 7 | 1 | 2 | 8 | 0.6 | 416 | 52 | 2095.6 | 300.7 | 2400.1 | 2556.1 | 326 | 53.9 |
| 102 | 9 | 23 | 7 | 1 | 2 | 16 | 0.4 | 880 | 55 | 1320.3 | 1076.3 | 2400.1 | 2565.1 | 470 | 106.9 |
| 102 | 9 | 24 | 7 | 1 | 2 | 32 | 0.6 | 1184 | 37 | 571.6 | 1825.7 | 2400.1 | 2511.1 | 315 | 75.9 |
| 102 | 9 | 27 | 7 | 1 | 2 | 64 | 2.6 | 2007 | 31 | 417 | 1978.8 | 2400.1 | 2493.1 | 302 | 78.2 |
| 102 | 9 | 28 | 7 | 1 | 2 | 128 | 1.3 | 1275 | 9 | 87.5 | 2310.9 | 2400.1 | 2427.1 | 109 | 21.6 |
| 102 | 9 | 30 | 7 | 1 | 2 | 256 | 1.7 | 512 | 2 | 28.8 | 2369.4 | 2400.1 | 2406.1 | 19 | 5.2 |
| 102 | 9 | 31 | 7 | 1 | 2 | 512 | 0.7 | 840 | 1 | 5.4 | 2394 | 2400.1 | 2403.1 | 8 | 2.6 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 103 | 9 | 6 | 7 | 1 | 2 | 1 | 67.5 | 224 | 224 | 2308.8 | 10.5 | 2400.1 | 3072.1 | 1230 | 135.9 |
| 103 | 9 | 9 | 7 | 1 | 2 | 2 | 42.4 | 92 | 46 | 2283.7 | 71.4 | 2400.1 | 2538.1 | 397 | 108 |
| 103 | 9 | 13 | 7 | 1 | 2 | 4 | 25.7 | 280 | 70 | 1541.3 | 829.1 | 2400.1 | 2610.1 | 476 | 120.9 |
| 103 | 9 | 17 | 7 | 1 | 2 | 8 | 6.4 | 515 | 64 | 934 | 1455.5 | 2400.1 | 2592.1 | 418 | 113.8 |
| 103 | 9 | 20 | 7 | 1 | 2 | 16 | 13.8 | 576 | 36 | 1164 | 1220.2 | 2400.1 | 2508.1 | 325 | 70.1 |
| 103 | 9 | 21 | 7 | 1 | 2 | 32 | 0.5 | 800 | 25 | 1536.6 | 861.6 | 2400.1 | 2475.1 | 168 | 47.1 |
| 103 | 9 | 23 | 7 | 1 | 2 | 64 | 1.7 | 196 | 3 | 111.1 | 2287.3 | 2400.1 | 2409.1 | 17 | 4.7 |
| 103 | 9 | 24 | 7 | 1 | 2 | 128 | 1.1 | 722 | 5 | 131.6 | 2267.3 | 2400.1 | 2415.1 | 32 | 8.3 |
| 103 | 9 | 27 | 7 | 1 | 2 | 256 | 0.6 | 885 | 3 | 25.2 | 2374.1 | 2400.1 | 2409.1 | 19 | 5.5 |
| | | | | | | | | | | | | | | | |
| 104 | 9 | 7 | 7 | 1 | 2 | 1 | 0.9 | 26 | 26 | 2396.6 | 1.4 | 2400.1 | 2478.1 | 138 | 31.3 |
| 104 | 9 | 11 | 7 | 1 | 2 | 2 | 1.9 | 172 | 86 | 2320.1 | 73.4 | 2400.1 | 2658.1 | 408 | 120.6 |
| 104 | 9 | 18 | 7 | 1 | 2 | 4 | 2.6 | 180 | 45 | 2283.3 | 111.6 | 2400.1 | 2535.1 | 256 | 82.3 |
| 104 | 9 | 21 | 7 | 1 | 2 | 8 | 0.6 | 873 | 109 | 1257.9 | 1135.8 | 2400.1 | 2727.1 | 604 | 182.4 |
| 104 | 9 | 23 | 7 | 1 | 2 | 16 | 0.9 | 1152 | 72 | 1838.2 | 557.7 | 2400.1 | 2616.1 | 468 | 130.3 |
| 104 | 9 | 24 | 7 | 1 | 2 | 32 | 0.5 | 1504 | 47 | 803.2 | 1593.5 | 2400.1 | 2541.1 | 228 | 68.6 |
| 104 | 9 | 27 | 7 | 1 | 2 | 64 | 1.3 | 2496 | 39 | 440.1 | 1956.3 | 2400.1 | 2517.1 | 283 | 85.7 |
| 104 | 9 | 28 | 7 | 1 | 2 | 128 | 0.6 | 1926 | 15 | 188.3 | 2210.7 | 2400.1 | 2445.1 | 95 | 31.4 |
| 104 | 9 | 30 | 7 | 1 | 2 | 256 | 2.6 | 1769 | 6 | 70.4 | 2326.7 | 2400.1 | 2418.1 | 44 | 15.1 |
| 104 | 9 | 31 | 7 | 1 | 2 | 512 | 0.9 | 616 | 1 | 5.4 | 2393.8 | 2400.1 | 2403.1 | 6 | 2.8 |
| | | | | | | | | | | | | | | | |
| 105 | 9 | 7 | 7 | 1 | 2 | 1 | 0.5 | 188 | 188 | 2379.1 | 8.9 | 2400.1 | 2964.1 | 968 | 251 |
| 105 | 9 | 11 | 7 | 1 | 2 | 2 | 0.6 | 254 | 127 | 1442.7 | 950 | 2400.1 | 2781.1 | 580 | 177.5 |
| 105 | 9 | 16 | 7 | 1 | 2 | 4 | 0.7 | 549 | 137 | 1829.9 | 561.5 | 2400.1 | 2811.1 | 701 | 191.6 |
| 105 | 9 | 18 | 7 | 1 | 2 | 8 | 0.8 | 713 | 89 | 545.7 | 1848.4 | 2400.1 | 2667.1 | 337 | 105.9 |
| 105 | 9 | 21 | 7 | 1 | 2 | 16 | 0.5 | 1345 | 84 | 1108.1 | 1286.9 | 2400.1 | 2652.1 | 364 | 122.6 |
| 105 | 9 | 23 | 7 | 1 | 2 | 32 | 0.2 | 2904 | 90 | 640.8 | 1754 | 2400.1 | 2670.1 | 463 | 121.5 |
| 105 | 9 | 24 | 7 | 1 | 2 | 64 | 0.6 | 2216 | 34 | 381.7 | 2015.7 | 2400.1 | 2502.1 | 158 | 40 |
| 105 | 9 | 27 | 7 | 1 | 2 | 128 | 4.9 | 2932 | 22 | 244.7 | 2149.2 | 2400.1 | 2466.1 | 114 | 28.9 |
| 105 | 9 | 28 | 7 | 1 | 2 | 256 | 0 | 2790 | 10 | 176.3 | 2223 | 2400.1 | 2430.1 | 54 | 16.3 |
| 105 | 9 | 30 | 7 | 1 | 2 | 512 | 0 | 2557 | 4 | 75 | 2325 | 2400.1 | 2412.1 | 22 | 6.7 |
| 105 | 9 | 31 | 7 | 1 | 2 | 1024 | 0.5 | 1486 | 1 | 30.3 | 2369.2 | 2400.1 | 2403.1 | 5 | 1.9 |
| | | | | | | | | | | | | | | | |
| 106 | 9 | 7 | 7 | 1 | 2 | 1 | 1.1 | 302 | 302 | 2367 | 13.9 | 2400.1 | 3306.1 | 1048 | 140.2 |
| 106 | 9 | 11 | 7 | 1 | 2 | 2 | 1 | 304 | 152 | 2261.8 | 127.9 | 2400.1 | 2856.1 | 472 | 171.7 |
| 106 | 9 | 16 | 7 | 1 | 2 | 4 | 0.8 | 672 | 168 | 1396.8 | 993.9 | 2400.1 | 2904.1 | 656 | 204.3 |
| 106 | 9 | 18 | 7 | 1 | 2 | 8 | 0.8 | 626 | 78 | 715.7 | 1679.8 | 2400.1 | 2634.1 | 346 | 123.5 |
| 106 | 9 | 21 | 7 | 1 | 2 | 16 | 1.1 | 1315 | 82 | 790.7 | 1603.5 | 2400.1 | 2646.1 | 414 | 154.6 |
| 106 | 9 | 23 | 7 | 1 | 2 | 32 | 0.5 | 1886 | 58 | 866.4 | 1530.3 | 2400.1 | 2574.1 | 286 | 122 |
| 106 | 9 | 24 | 7 | 1 | 2 | 64 | 0.3 | 2043 | 31 | 535.8 | 1862.6 | 2400.1 | 2493.1 | 153 | 60.7 |
| 106 | 9 | 27 | 7 | 1 | 2 | 128 | 3.8 | 2130 | 16 | 237.4 | 2158 | 2400.1 | 2448.1 | 109 | 33.1 |
| 106 | 9 | 28 | 7 | 1 | 2 | 256 | 1 | 1949 | 7 | 67.4 | 2331.5 | 2400.1 | 2421.1 | 36 | 17.4 |
| 106 | 9 | 30 | 7 | 1 | 2 | 512 | 0.7 | 1047 | 2 | 23.9 | 2375.3 | 2400.1 | 2406.1 | 11 | 5.1 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 9 | 10 | 8 | 1 | 3 | 1 | 0.4 | 290 | 290 | 2368 | 16.1 | 2400.1 | 3270.1 | 300 | 171.2 |
| 101 | 9 | 12 | 8 | 1 | 3 | 2 | 0.8 | 316 | 158 | 2158.1 | 232.4 | 2400.1 | 2874.1 | 64 | 58.9 |
| 101 | 9 | 14 | 8 | 1 | 3 | 4 | 0.5 | 635 | 158 | 2013.9 | 377.8 | 2400.1 | 2874.1 | 223 | 103.8 |
| 101 | 9 | 17 | 8 | 1 | 3 | 8 | 4 | 873 | 109 | 1296.8 | 1093.2 | 2400.1 | 2727.1 | 202 | 60.3 |
| 101 | 9 | 19 | 8 | 1 | 3 | 16 | 5.7 | 554 | 34 | 562.9 | 1830 | 2400.1 | 2502.1 | 3 | 11.9 |
| 101 | 9 | 20 | 8 | 1 | 3 | 32 | 0.6 | 224 | 7 | 2207.9 | 191.2 | 2400.1 | 2421.1 | 11 | 4 |
| 101 | 9 | 24 | 8 | 1 | 3 | 64 | 1.5 | 1984 | 31 | 313.1 | 2083.7 | 2400.1 | 2493.1 | 119 | 24.6 |
| 101 | 9 | 27 | 8 | 1 | 3 | 128 | 17.9 | 465 | 3 | 13.7 | 2368.4 | 2400.1 | 2409.1 | 6 | 2.3 |
| 101 | 9 | 28 | 8 | 1 | 3 | 256 | 0.1 | 753 | 2 | 9.9 | 2390.1 | 2400.1 | 2406.1 | 8 | 2.2 |
| 101 | 9 | 31 | 8 | 1 | 3 | 512 | 0.5 | 866 | 1 | 2.4 | 2397.2 | 2400.1 | 2403.1 | 4 | 1.3 |
| | | | | | | | | | | | | | | | |
| 102 | 9 | 10 | 8 | 1 | 3 | 1 | 13.8 | 240 | 240 | 2360.9 | 10.8 | 2400.1 | 3120.1 | 1580 | 174.5 |
| 102 | 9 | 12 | 8 | 1 | 3 | 2 | 0.8 | 404 | 202 | 1716.4 | 671.2 | 2400.1 | 3006.1 | 420 | 86.2 |
| 102 | 9 | 14 | 8 | 1 | 3 | 4 | 3 | 688 | 172 | 2049.3 | 337.8 | 2400.1 | 2916.1 | 706 | 136 |
| 102 | 9 | 17 | 8 | 1 | 3 | 8 | 6.1 | 526 | 65 | 969.7 | 1420.8 | 2400.1 | 2595.1 | 487 | 80.1 |
| 102 | 9 | 19 | 8 | 1 | 3 | 16 | 4.2 | 753 | 47 | 1455.5 | 937.6 | 2400.1 | 2541.1 | 440 | 81.5 |
| 102 | 9 | 24 | 8 | 1 | 3 | 32 | 3.1 | 1077 | 33 | 568 | 1827.4 | 2400.1 | 2499.1 | 290 | 71.7 |
| 102 | 9 | 25 | 8 | 1 | 3 | 64 | 0.7 | 1804 | 28 | 677.3 | 1720.4 | 2400.1 | 2484.1 | 279 | 64.9 |
| 102 | 9 | 26 | 8 | 1 | 3 | 128 | 8 | 1208 | 9 | 282.6 | 2109 | 2400.1 | 2427.1 | 110 | 20.6 |
| 102 | 9 | 27 | 8 | 1 | 3 | 256 | 4.4 | 1756 | 6 | 95.2 | 2300.2 | 2400.1 | 2418.1 | 70 | 14 |
| | | | | | | | | | | | | | | | |
| 103 | 9 | 10 | 8 | 1 | 3 | 1 | 47.8 | 100 | 100 | 2341.4 | 4.6 | 2400.1 | 2700.1 | 589 | 162.5 |
| 103 | 9 | 12 | 8 | 1 | 3 | 2 | 6.6 | 141 | 70 | 1062.1 | 1327.9 | 2400.1 | 2610.1 | 362 | 104.8 |
| 103 | 9 | 14 | 8 | 1 | 3 | 4 | 25.4 | 300 | 75 | 1602.5 | 768.1 | 2400.1 | 2625.1 | 427 | 132.9 |
| 103 | 9 | 17 | 8 | 1 | 3 | 8 | 5.1 | 380 | 47 | 1721.8 | 670.7 | 2400.1 | 2541.1 | 287 | 84.7 |
| 103 | 9 | 19 | 8 | 1 | 3 | 16 | 21.1 | 720 | 45 | 1277.3 | 1099.6 | 2400.1 | 2535.1 | 322 | 88.5 |
| 103 | 9 | 20 | 8 | 1 | 3 | 32 | 1.7 | 389 | 12 | 1080 | 1317.8 | 2400.1 | 2436.1 | 85 | 22.3 |
| 103 | 9 | 24 | 8 | 1 | 3 | 64 | 1.2 | 663 | 10 | 346.1 | 2052.2 | 2400.1 | 2430.1 | 81 | 22.2 |
| 103 | 9 | 25 | 8 | 1 | 3 | 128 | 1.1 | 1286 | 10 | 96.4 | 2302.1 | 2400.1 | 2430.1 | 64 | 16.8 |
| 103 | 9 | 26 | 8 | 1 | 3 | 256 | 1.2 | 278 | 1 | 79.8 | 2319.1 | 2400.1 | 2403.1 | 7 | 1.7 |
| 103 | 9 | 27 | 8 | 1 | 3 | 512 | 0.9 | 981 | 1 | 7.6 | 2391.6 | 2400.1 | 2403.1 | 5 | 1.7 |
| | | | | | | | | | | | | | | | |
| 104 | 9 | 11 | 8 | 1 | 3 | 1 | 1.7 | 111 | 111 | 2386.6 | 5.3 | 2400.1 | 2733.1 | 565 | 173 |
| 104 | 9 | 13 | 8 | 1 | 3 | 2 | 0.5 | 198 | 99 | 2237.8 | 156.3 | 2400.1 | 2697.1 | 521 | 151.7 |
| 104 | 9 | 15 | 8 | 1 | 3 | 4 | 0.4 | 175 | 43 | 2146.9 | 249.9 | 2400.1 | 2529.1 | 243 | 67.7 |
| 104 | 9 | 18 | 8 | 1 | 3 | 8 | 1.6 | 536 | 67 | 1766 | 629 | 2400.1 | 2601.1 | 397 | 117.8 |
| 104 | 9 | 19 | 8 | 1 | 3 | 16 | 1.5 | 545 | 34 | 1436.8 | 959.8 | 2400.1 | 2502.1 | 178 | 36.8 |
| 104 | 9 | 20 | 8 | 1 | 3 | 32 | 1 | 192 | 6 | 2187.1 | 211.6 | 2400.1 | 2418.1 | 41 | 10.4 |
| 104 | 9 | 24 | 8 | 1 | 3 | 64 | 0.2 | 1563 | 24 | 427 | 1971.5 | 2400.1 | 2472.1 | 195 | 49 |
| 104 | 9 | 25 | 8 | 1 | 3 | 128 | 1.1 | 1356 | 10 | 111.3 | 2287.1 | 2400.1 | 2430.1 | 76 | 22.1 |
| 104 | 9 | 27 | 8 | 1 | 3 | 256 | 0.6 | 1092 | 4 | 76.2 | 2322.9 | 2400.1 | 2412.1 | 31 | 8.7 |
| 104 | 9 | 28 | 8 | 1 | 3 | 512 | 1 | 881 | 1 | 17.9 | 2381.1 | 2400.1 | 2403.1 | 9 | 2.6 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 105 | 9 | 13 | 8 | 1 | 3 | 1 | 2.2 | 113 | 113 | 2385.9 | 5.4 | 2400.1 | 2739.1 | 643 | 179.4 |
| 105 | 9 | 15 | 8 | 1 | 3 | 2 | 1 | 221 | 110 | 1445.3 | 947.8 | 2400.1 | 2730.1 | 570 | 153.8 |
| 105 | 9 | 18 | 8 | 1 | 3 | 4 | 0.8 | 684 | 171 | 2082 | 307.3 | 2400.1 | 2913.1 | 636 | 216 |
| 105 | 9 | 19 | 8 | 1 | 3 | 8 | 0.6 | 408 | 51 | 1946.7 | 450.3 | 2400.1 | 2553.1 | 221 | 59.6 |
| 105 | 9 | 20 | 8 | 1 | 3 | 16 | 0.7 | 1280 | 80 | 1689.6 | 705.3 | 2400.1 | 2640.1 | 369 | 124.9 |
| 105 | 9 | 24 | 8 | 1 | 3 | 32 | 0.4 | 2661 | 83 | 700.7 | 1694.3 | 2400.1 | 2649.1 | 443 | 139.4 |
| 105 | 9 | 25 | 8 | 1 | 3 | 64 | 0.5 | 1030 | 16 | 185.4 | 2213.7 | 2400.1 | 2448.1 | 81 | 19.7 |
| 105 | 9 | 26 | 8 | 1 | 3 | 128 | 0.7 | 2900 | 22 | 401.2 | 1996.9 | 2400.1 | 2466.1 | 104 | 36.8 |
| 105 | 9 | 27 | 8 | 1 | 3 | 256 | 0.3 | 2419 | 9 | 212.9 | 2186.5 | 2400.1 | 2427.1 | 40 | 13.5 |
| 105 | 9 | 28 | 8 | 1 | 3 | 512 | 0.6 | 2423 | 4 | 66.6 | 2332.6 | 2400.1 | 2412.1 | 20 | 5.9 |
| 105 | 9 | 31 | 8 | 1 | 3 | 1024 | 0.6 | 1598 | 1 | 11.5 | 2388 | 2400.1 | 2403.1 | 4 | 1.4 |
| | | | | | | | | | | | | | | | |
| 106 | 9 | 11 | 8 | 1 | 3 | 1 | 0.6 | 252 | 252 | 2372.9 | 13.6 | 2400.1 | 3156.1 | 577 | -14.1 |
| 106 | 9 | 13 | 8 | 1 | 3 | 2 | 0.7 | 216 | 108 | 2333.4 | 60.2 | 2400.1 | 2724.1 | 352 | 127.8 |
| 106 | 9 | 15 | 8 | 1 | 3 | 4 | 0.5 | 340 | 85 | 2267.7 | 127.5 | 2400.1 | 2655.1 | 478 | 158.5 |
| 106 | 9 | 18 | 8 | 1 | 3 | 8 | 0.5 | 680 | 85 | 1998.4 | 397 | 2400.1 | 2655.1 | 396 | 146.7 |
| 106 | 9 | 19 | 8 | 1 | 3 | 16 | 0.7 | 1157 | 72 | 1135.9 | 1259.7 | 2400.1 | 2616.1 | 374 | 124.2 |
| 106 | 9 | 20 | 8 | 1 | 3 | 32 | 1.2 | 454 | 14 | 701 | 1697.2 | 2400.1 | 2442.1 | 68 | 18.3 |
| 106 | 9 | 24 | 8 | 1 | 3 | 64 | 1.5 | 1917 | 29 | 383.6 | 2013.5 | 2400.1 | 2487.1 | 150 | 48.1 |
| 106 | 9 | 25 | 8 | 1 | 3 | 128 | 0.5 | 2780 | 21 | 350.3 | 2048.1 | 2400.1 | 2463.1 | 120 | 47.1 |
| 106 | 9 | 26 | 8 | 1 | 3 | 256 | 0.9 | 663 | 2 | 31 | 2368.1 | 2400.1 | 2406.1 | 12 | 4.4 |
| | | | | | | | | | | | | | | | |
| 101 | 9 | 6 | 10 | 2 | 2 | 1 | 0.6 | 419 | 419 | 2356.4 | 19.7 | 2400.1 | 3657.1 | 1620 | 24.4 |
| 101 | 9 | 8 | 10 | 2 | 2 | 2 | 0.5 | 778 | 389 | 1570.3 | 808.2 | 2400.1 | 3567.1 | 1297 | 14.4 |
| 101 | 9 | 12 | 10 | 2 | 2 | 4 | 0.4 | 1431 | 357 | 1471.1 | 909.1 | 2400.1 | 3471.1 | 1283 | 39.6 |
| 101 | 9 | 14 | 10 | 2 | 2 | 8 | 1.6 | 2648 | 331 | 1090.4 | 1290.9 | 2400.1 | 3393.1 | 1944 | 47.8 |
| 101 | 9 | 17 | 10 | 2 | 2 | 16 | 1.8 | 1680 | 105 | 1118.9 | 1273.5 | 2400.1 | 2715.1 | 766 | 18.9 |
| 101 | 9 | 18 | 10 | 2 | 2 | 32 | 0.6 | 2046 | 63 | 708.5 | 1687.7 | 2400.1 | 2589.1 | 384 | 12.4 |
| 101 | 9 | 19 | 10 | 2 | 2 | 64 | 0.4 | 3027 | 47 | 658.2 | 1739 | 2400.1 | 2541.1 | 337 | 9.7 |
| 101 | 9 | 20 | 10 | 2 | 2 | 128 | 0 | 1700 | 13 | 625.6 | 1773.9 | 2400.1 | 2439.1 | 95 | 3.1 |
| 101 | 9 | 21 | 10 | 2 | 2 | 256 | 1.7 | 491 | 1 | 2.5 | 2395.8 | 2400.1 | 2403.1 | 4 | 1.3 |
| 101 | 9 | 22 | 10 | 2 | 2 | 512 | 0.4 | 950 | 1 | 3.6 | 2396 | 2400.1 | 2403.1 | 6 | 0.5 |
| | | | | | | | | | | | | | | | |
| 102 | 9 | 6 | 10 | 2 | 2 | 1 | 0.7 | 439 | 439 | 2352.9 | 21.3 | 2400.1 | 3717.1 | 2235 | 22.4 |
| 102 | 9 | 8 | 10 | 2 | 2 | 2 | 0.4 | 470 | 235 | 2251 | 134.9 | 2400.1 | 3105.1 | 1017 | 27 |
| 102 | 9 | 12 | 10 | 2 | 2 | 4 | 1.2 | 1240 | 310 | 1738.1 | 643.3 | 2400.1 | 3330.1 | 2058 | 43.5 |
| 102 | 9 | 14 | 10 | 2 | 2 | 8 | 1.8 | 1777 | 222 | 1024.2 | 1362.9 | 2400.1 | 3066.1 | 1895 | 42.6 |
| 102 | 9 | 17 | 10 | 2 | 2 | 16 | 3.8 | 1536 | 96 | 1262.1 | 1128.3 | 2400.1 | 2688.1 | 960 | 20.6 |
| 102 | 9 | 18 | 10 | 2 | 2 | 32 | 0.9 | 676 | 21 | 1142.2 | 1256 | 2400.1 | 2463.1 | 201 | 4.4 |
| 102 | 9 | 19 | 10 | 2 | 2 | 64 | 1.4 | 647 | 10 | 842.7 | 1555.5 | 2400.1 | 2430.1 | 101 | 2.1 |
| 102 | 9 | 20 | 10 | 2 | 2 | 128 | 0.4 | 878 | 6 | 110.5 | 2288.8 | 2400.1 | 2418.1 | 67 | 1.2 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 103 | 9 | 6 | 10 | 2 | 2 | 1 | 4.7 | 371 | 371 | 2356.3 | 18.7 | 2400.1 | 3513.1 | 1495 | 10.1 |
| 103 | 9 | 12 | 10 | 2 | 2 | 2 | 4.4 | 238 | 119 | 1907.3 | 483.1 | 2400.1 | 2757.1 | 674 | 15.2 |
| 103 | 9 | 14 | 10 | 2 | 2 | 4 | 8.1 | 660 | 165 | 1892 | 490.9 | 2400.1 | 2895.1 | 992 | 24.3 |
| 103 | 9 | 17 | 10 | 2 | 2 | 8 | 1.6 | 1234 | 154 | 1311.9 | 1078 | 2400.1 | 2862.1 | 1220 | 29.7 |
| 103 | 9 | 18 | 10 | 2 | 2 | 16 | 1.3 | 1168 | 73 | 1417.1 | 977.2 | 2400.1 | 2619.1 | 578 | 14.6 |
| 103 | 9 | 19 | 10 | 2 | 2 | 32 | 5.9 | 1220 | 38 | 1338.7 | 1053.4 | 2400.1 | 2514.1 | 308 | 8.3 |
| 103 | 9 | 20 | 10 | 2 | 2 | 64 | 1.3 | 960 | 15 | 1098.8 | 1299.2 | 2400.1 | 2445.1 | 103 | 2.4 |
| 103 | 9 | 21 | 10 | 2 | 2 | 128 | 0.9 | 384 | 3 | 1722 | 676.9 | 2400.1 | 2409.1 | 19 | 1 |
| | | | | | | | | | | | | | | | |
| 104 | 9 | 5 | 10 | 2 | 2 | 1 | 1.1 | 328 | 328 | 2364.8 | 17.1 | 2400.1 | 3384.1 | 1865 | 48.1 |
| 104 | 9 | 7 | 10 | 2 | 2 | 2 | 0.8 | 732 | 366 | 2049.8 | 330 | 2400.1 | 3498.1 | 2232 | 56.7 |
| 104 | 9 | 9 | 10 | 2 | 2 | 4 | 0.9 | 1452 | 363 | 1707.9 | 670.7 | 2400.1 | 3489.1 | 2505 | 32.8 |
| 104 | 9 | 13 | 10 | 2 | 2 | 8 | 1.2 | 2368 | 296 | 1452.1 | 930.3 | 2400.1 | 3288.1 | 2047 | 54.3 |
| 104 | 9 | 15 | 10 | 2 | 2 | 16 | 0.5 | 2657 | 166 | 1085.8 | 1305.1 | 2400.1 | 2898.1 | 1345 | 29.5 |
| 104 | 9 | 18 | 10 | 2 | 2 | 32 | 0.7 | 1504 | 47 | 1481.4 | 915.3 | 2400.1 | 2541.1 | 373 | 10 |
| 104 | 9 | 19 | 10 | 2 | 2 | 64 | 1.2 | 768 | 12 | 1041.3 | 1357.1 | 2400.1 | 2436.1 | 81 | 4.3 |
| 104 | 9 | 20 | 10 | 2 | 2 | 128 | 0 | 771 | 6 | 871.5 | 1528.3 | 2400.1 | 2418.1 | 39 | 1.1 |
| 104 | 9 | 21 | 10 | 2 | 2 | 256 | 0.4 | 483 | 1 | 100.2 | 2299.4 | 2400.1 | 2403.1 | 8 | 0.4 |
| | | | | | | | | | | | | | | | |
| 105 | 9 | 5 | 10 | 2 | 2 | 1 | 0.7 | 262 | 262 | 2371.6 | 13.3 | 2400.1 | 3186.1 | 1005 | 32.9 |
| 105 | 9 | 7 | 10 | 2 | 2 | 2 | 0.8 | 698 | 349 | 2095.2 | 285.1 | 2400.1 | 3447.1 | 1243 | 43 |
| 105 | 9 | 9 | 10 | 2 | 2 | 4 | 0.6 | 944 | 236 | 2037.7 | 348.4 | 2400.1 | 3108.1 | 1010 | 33.5 |
| 105 | 9 | 13 | 10 | 2 | 2 | 8 | 0.6 | 1848 | 231 | 1487 | 898.7 | 2400.1 | 3093.1 | 925 | 30.3 |
| 105 | 9 | 15 | 10 | 2 | 2 | 16 | 0.4 | 2640 | 165 | 908.4 | 1483.3 | 2400.1 | 2895.1 | 945 | 28.6 |
| 105 | 9 | 18 | 10 | 2 | 2 | 32 | 0.5 | 2920 | 91 | 786.7 | 1607.8 | 2400.1 | 2673.1 | 620 | 18.4 |
| 105 | 9 | 19 | 10 | 2 | 2 | 64 | 0.9 | 1089 | 17 | 730.7 | 1667.5 | 2400.1 | 2451.1 | 83 | 3.1 |
| 105 | 9 | 20 | 10 | 2 | 2 | 128 | 0.9 | 1282 | 10 | 628.2 | 1770.5 | 2400.1 | 2430.1 | 48 | 1.7 |
| 105 | 9 | 21 | 10 | 2 | 2 | 256 | 0.7 | 651 | 2 | 144.6 | 2254.7 | 2400.1 | 2406.1 | 9 | 0.6 |
| | | | | | | | | | | | | | | | |
| 106 | 9 | 5 | 10 | 2 | 2 | 1 | 6.6 | 468 | 468 | 2344.1 | 24.4 | 2400.1 | 3804.1 | 1312 | 42.9 |
| 106 | 9 | 7 | 10 | 2 | 2 | 2 | 3.6 | 723 | 361 | 1401.8 | 974.9 | 2400.1 | 3483.1 | 1783 | 53.1 |
| 106 | 9 | 9 | 10 | 2 | 2 | 4 | 0.8 | 1596 | 399 | 1745.7 | 633.2 | 2400.1 | 3597.1 | 2228 | 65.76 |
| 106 | 9 | 13 | 10 | 2 | 2 | 8 | 1.8 | 2187 | 273 | 1483.3 | 899 | 2400.1 | 3219.1 | 1714 | 51.4 |
| 106 | 9 | 15 | 10 | 2 | 2 | 16 | 1.1 | 2480 | 155 | 1104.9 | 1286.3 | 2400.1 | 2865.1 | 1068 | 33.2 |
| 106 | 9 | 18 | 10 | 2 | 2 | 32 | 1.1 | 2795 | 87 | 894 | 1500.1 | 2400.1 | 2661.1 | 643 | 19.1 |
| 106 | 9 | 19 | 10 | 2 | 2 | 64 | 2 | 1290 | 20 | 632 | 1765.1 | 2400.1 | 2460.1 | 102 | 3.7 |
| 106 | 9 | 20 | 10 | 2 | 2 | 128 | 1.7 | 898 | 7 | 537.4 | 1860.6 | 2400.1 | 2421.1 | 33 | 1.3 |
| 106 | 9 | 21 | 10 | 2 | 2 | 256 | 5 | 487 | 1 | 98.6 | 2296.4 | 2400.1 | 2403.1 | 7 | 0.3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 9 | 30 | 10 | 2 | 3 | 1 | 0.4 | 361 | 361 | 2361.5 | 17.9 | 2400.1 | 3483.1 | 1082 | 8.3 |
| 101 | 9 | 1 | 11 | 2 | 3 | 2 | 0.4 | 990 | 495 | 1998.2 | 374.5 | 2400.1 | 3885.1 | 2118 | 37.3 |
| 101 | 9 | 3 | 11 | 2 | 3 | 4 | 0.6 | 132 | 33 | 2284.6 | 112.8 | 2400.1 | 2499.1 | 55 | 2.2 |
| 101 | 9 | 5 | 11 | 2 | 3 | 8 | 0.3 | 1616 | 202 | 1767.3 | 620.8 | 2400.1 | 3006.1 | 1085 | 27.4 |
| 101 | 9 | 7 | 11 | 2 | 3 | 8 | 0.5 | 2176 | 272 | 1318.4 | 1066.1 | 2400.1 | 3216.1 | 1274 | 36.3 |
| 101 | 9 | 9 | 11 | 2 | 3 | 16 | 0.8 | 2306 | 144 | 878.2 | 1513.7 | 2400.1 | 2832.1 | 785 | 21.1 |
| 101 | 9 | 10 | 11 | 2 | 3 | 32 | 0.5 | 1064 | 33 | 1231.8 | 1165.9 | 2400.1 | 2499.1 | 194 | 7.2 |
| 101 | 9 | 11 | 11 | 2 | 3 | 64 | 0.3 | 695 | 10 | 277 | 2122.1 | 2400.1 | 2430.1 | 59 | 2.4 |
| 101 | 9 | 15 | 11 | 2 | 3 | 128 | 0.3 | 1345 | 10 | 225.5 | 2174.2 | 2400.1 | 2430.1 | 56 | 2.6 |
| 101 | 9 | 16 | 11 | 2 | 3 | 256 | 0.4 | 1158 | 4 | 344.7 | 2054.9 | 2400.1 | 2412.1 | 23 | 1.2 |
| 101 | 9 | 17 | 11 | 2 | 3 | 512 | 0.5 | 1809 | 3 | 21.6 | 2377.9 | 2400.1 | 2409.1 | 19 | 1 |
| | | | | | | | | | | | | | | | |
| 102 | 9 | 30 | 10 | 2 | 3 | 1 | 2.4 | 391 | 391 | 2356 | 19.5 | 2400.1 | 3573.1 | 2487 | 24.3 |
| 102 | 9 | 1 | 11 | 2 | 3 | 2 | 1.1 | 852 | 426 | 1878.1 | 496.7 | 2400.1 | 3678.1 | 3001 | 22.8 |
| 102 | 9 | 3 | 11 | 2 | 3 | 4 | 0.4 | 1236 | 309 | 1513.1 | 870.1 | 2400.1 | 3327.1 | 2687 | 55.7 |
| 102 | 9 | 7 | 11 | 2 | 3 | 8 | 0.8 | 1256 | 157 | 1249 | 1141.9 | 2400.1 | 2871.1 | 1556 | 30.6 |
| 102 | 9 | 9 | 11 | 2 | 3 | 16 | 0 | 896 | 56 | 1486.4 | 910.2 | 2400.1 | 2568.1 | 433 | 9.2 |
| 102 | 9 | 10 | 11 | 2 | 3 | 32 | 0.3 | 928 | 29 | 1578.3 | 819.5 | 2400.1 | 2487.1 | 293 | 8.7 |
| 102 | 9 | 11 | 11 | 2 | 3 | 64 | 9.8 | 199 | 3 | 334.8 | 2055.4 | 2400.1 | 2409.1 | 20 | 0.7 |
| 102 | 9 | 15 | 11 | 2 | 3 | 128 | 9.3 | 213 | 1 | 635.8 | 1755 | 2400.1 | 2403.1 | 3 | 0.4 |
| | | | | | | | | | | | | | | | |
| 103 | 9 | 30 | 10 | 2 | 3 | 1 | 23.2 | 317 | 317 | 2343.2 | 17.3 | 2400.1 | 3351.1 | 1365 | 37.5 |
| 103 | 9 | 1 | 11 | 2 | 3 | 2 | 0.5 | 578 | 289 | 2038.1 | 344.4 | 2400.1 | 3267.1 | 1361 | 36.6 |
| 103 | 9 | 3 | 11 | 2 | 3 | 4 | 0 | 700 | 175 | 1919.7 | 469.5 | 2400.1 | 2925.1 | 1191 | 29.1 |
| 103 | 9 | 7 | 11 | 2 | 3 | 8 | 2.2 | 1352 | 169 | 1203.5 | 1184.7 | 2400.1 | 2907.1 | 1117 | 27.7 |
| 103 | 9 | 9 | 11 | 2 | 3 | 16 | 1 | 513 | 32 | 1621.6 | 775.8 | 2400.1 | 2496.1 | 171 | 5 |
| 103 | 9 | 10 | 11 | 2 | 3 | 32 | 9.7 | 1413 | 44 | 792.1 | 1596.2 | 2400.1 | 2532.1 | 334 | 10.3 |
| 103 | 9 | 11 | 11 | 2 | 3 | 64 | 5.2 | 448 | 7 | 1029.3 | 1365.3 | 2400.1 | 2421.1 | 22 | 0.8 |
| 103 | 9 | 15 | 11 | 2 | 3 | 128 | 1.1 | 293 | 2 | 91.3 | 2307.7 | 2400.1 | 2406.1 | 0 | 0.4 |
| | | | | | | | | | | | | | | | |
| 104 | 9 | 31 | 10 | 2 | 3 | 1 | 5 | 87 | 87 | 2385.7 | 4.5 | 2400.1 | 2661.1 | 532 | 11.4 |
| 104 | 9 | 2 | 11 | 2 | 3 | 2 | 4.1 | 720 | 360 | 2137.8 | 236.7 | 2400.1 | 3480.1 | 2492 | 51.3 |
| 104 | 9 | 4 | 11 | 2 | 3 | 4 | 0.8 | 1696 | 424 | 1683.4 | 693.3 | 2400.1 | 3672.1 | 2635 | 55.2 |
| 104 | 9 | 8 | 11 | 2 | 3 | 8 | 0.7 | 2480 | 310 | 1308.4 | 1075.3 | 2400.1 | 3330.1 | 1791 | 47.3 |
| 104 | 9 | 9 | 11 | 2 | 3 | 16 | 0.4 | 2528 | 158 | 1240.7 | 1149.9 | 2400.1 | 2874.1 | 799 | 22.6 |
| 104 | 9 | 10 | 11 | 2 | 3 | 32 | 0.6 | 2167 | 67 | 1294 | 1101.8 | 2400.1 | 2601.1 | 491 | 13.1 |
| 104 | 9 | 11 | 11 | 2 | 3 | 64 | 1.1 | 2625 | 41 | 755.4 | 1641.2 | 2400.1 | 2523.1 | 318 | 8.1 |
| 104 | 9 | 15 | 11 | 2 | 3 | 128 | 0.8 | 1039 | 8 | 831.5 | 1567.2 | 2400.1 | 2424.1 | 48 | 2.4 |
| 104 | 9 | 16 | 11 | 2 | 3 | 256 | 0.6 | 279 | 1 | 7.9 | 2391.6 | 2400.1 | 2403.1 | 8 | 0.4 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 105 | 9 | 31 | 10 | 2 | 3 | 1 | 1 | 365 | 365 | 2362 | 19.6 | 2400.1 | 3495.1 | 907 | 32.3 |
| 105 | 9 | 2 | 11 | 2 | 3 | 2 | 2.9 | 770 | 385 | 1865.8 | 509.3 | 2400.1 | 3555.1 | 1185 | 42 |
| 105 | 9 | 4 | 11 | 2 | 3 | 4 | 0.5 | 1060 | 265 | 1923.8 | 461.9 | 2400.1 | 3195.1 | 1052 | 34 |
| 105 | 9 | 8 | 11 | 2 | 3 | 8 | 0.5 | 2160 | 270 | 1464.4 | 920.4 | 2400.1 | 3210.1 | 971 | 32.3 |
| 105 | 9 | 9 | 11 | 2 | 3 | 16 | 0.6 | 2591 | 161 | 1069.9 | 1320.1 | 2400.1 | 2883.1 | 723 | 20.4 |
| 105 | 9 | 10 | 11 | 2 | 3 | 32 | 1.1 | 3040 | 95 | 807.2 | 1587.2 | 2400.1 | 2685.1 | 634 | 23.1 |
| 105 | 9 | 12 | 11 | 2 | 3 | 64 | 0.6 | 2880 | 45 | 502.7 | 1894.5 | 2400.1 | 2535.1 | 205 | 10.1 |
| 105 | 9 | 15 | 11 | 2 | 3 | 128 | 0.4 | 1069 | 8 | 161.4 | 2237.9 | 2400.1 | 2424.1 | 35 | 1.7 |
| 105 | 9 | 16 | 11 | 2 | 3 | 256 | 0 | 552 | 2 | 124.9 | 2275.2 | 2400.1 | 2406.1 | 8 | 0.4 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 106 | 9 | 31 | 10 | 2 | 3 | 1 | 4.4 | 540 | 540 | 2339.6 | 26.2 | 2400.1 | 4020.1 | 2015 | 53 |
| 106 | 9 | 2 | 11 | 2 | 3 | 2 | 1.1 | 972 | 486 | 2089.1 | 282.5 | 2400.1 | 3858.1 | 2475 | 57.5 |
| 106 | 9 | 4 | 11 | 2 | 3 | 4 | 1.1 | 1512 | 378 | 1529 | 849.8 | 2400.1 | 3534.1 | 2235 | 57.7 |
| 106 | 9 | 8 | 11 | 2 | 3 | 8 | 2.6 | 2072 | 259 | 1479.3 | 905.4 | 2400.1 | 3177.1 | 1373 | 43.2 |
| 106 | 9 | 9 | 11 | 2 | 3 | 16 | 9.1 | 2592 | 162 | 1131.2 | 1251.5 | 2400.1 | 2886.1 | 986 | 34.3 |
| 106 | 9 | 10 | 11 | 2 | 3 | 32 | 0 | 2656 | 83 | 899.4 | 1495.7 | 2400.1 | 2649.1 | 478 | 16 |
| 106 | 9 | 12 | 11 | 2 | 3 | 64 | 2.4 | 1538 | 24 | 528.3 | 1868.1 | 2400.1 | 2472.1 | 81 | 4.7 |
| 106 | 9 | 15 | 11 | 2 | 3 | 128 | 2 | 222 | 1 | 5.4 | 2392.7 | 2400.1 | 2403.1 | 2 | 0.2 |

# APPENDIX B.

This appendix presents raw data from the cross-price demand assessment for Condition 1 (wheat vs. wheat), Condition 2 (puffed wheat vs. Puffed wheat) and Condition 3 (Wheat vs. Puffed wheat) of each hen for Experiment 2.

the hen number (Hen #), year (Year), day ( Day), month (Mth), the Condition (Cond), the left FR Schedule( LFR), the Right FR Schedule (RFR), the side of first response: 1=L 2=R (SFR), the latency to the first response (First), the total responses on the left key (LRsp), the total responses on the right key ( RRsp), the number of changes after PRP from left to left (PRPL>L), the number of changes after PRP from left to right (PRPL>R), the number of changes after PRP from right to left (PRPR>L), the number of changes after PRP from right to right (PRPR>R), the number of PRP on left to left ( NPRPL>L), the number of PRP on left to right ( NPRPL>R), the number of PRP on right to left (NPRPR>L), the number of PRP on right to right (NPRPR>R), the keytime ( KeyT), the total time ( TotT), the left Eat time(LEat_T), the right( REat-T), the weight of reinforcer eaten on left (LWRE), the weight of reinforcer eaten on right (RWRE) and the total number of changeover (CoD).

# APPENDIX B

| Hen # | Year | Day | Mth | Cond | LFR | RFR | | First | LRsp | RRsp | Lfts | Rfts | PRPL>L | PRPL>R | PRPR>L | PRPR>R | NPRPL>L | NPRPL>R | NPRPR>L | NPRPR>R | KeyT | TotT | LEat_T | REat-T | LWRE | RWRE | CoD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 10 | 1 | 2 | 1 | 1 | 256 | 1 | 7.4 | 260 | 0 | 260 | 0 | 1820.7 | 0 | 0 | 0 | 259 | 0 | 0 | 0 | 2400.1 | 3180.1 | 2.1 | 0 | 31.6 | 0.2 | 0 |
| 101 | 10 | 3 | 2 | 1 | 8 | 32 | 2 | 2 | 576 | 9 | 72 | 0 | 456.2 | 0 | 0 | 0 | 71 | 0 | 0 | 0 | 2400.1 | 2616.1 | 0 | 0 | 22.9 | 0 | 1 |
| 101 | 10 | 5 | 2 | 1 | 128 | 2 | 1 | 2.1 | 71 | 248 | 0 | 124 | 0 | 0 | 14 | 191.4 | 0 | 0 | 1 | 122 | 2400.1 | 2772.1 | 0 | 6.8 | 1 | 51.6 | 5 |
| 101 | 10 | 8 | 2 | 1 | 4 | 64 | 2 | 1.2 | 674 | 19 | 168 | 0 | 1201.1 | 0 | 0 | 0 | 168 | 0 | 0 | 0 | 2400.1 | 2904.1 | 0.1 | 0 | 43.2 | 0.2 | 1 |
| 101 | 10 | 10 | 2 | 1 | 256 | 1 | 1 | 1.8 | 133 | 303 | 0 | 303 | 0 | 0 | 0 | 685.6 | 0 | 0 | 0 | 302 | 2400.1 | 3309.1 | 0 | 0.9 | 0.7 | 93.1 | 1 |
| 101 | 10 | 12 | 2 | 1 | 32 | 8 | 1 | 1.4 | 17 | 248 | 0 | 31 | 0 | 0 | 0 | 513.6 | 0 | 0 | 0 | 30 | 2400.1 | 2493.1 | 0 | 0.2 | 0.8 | 8.3 | 1 |
| 101 | 10 | 14 | 2 | 1 | 2 | 128 | 2 | 2 | 612 | 53 | 306 | 0 | 1731.3 | 0 | 0 | 0 | 305 | 0 | 0 | 0 | 2400.1 | 3318.1 | 0 | 0 | 82 | 0.2 | 3 |
| 101 | 10 | 16 | 2 | 1 | 16 | 16 | 2 | 0 | 1360 | 1136 | 85 | 71 | 417.8 | 95.1 | 70.4 | 308.5 | 73 | 11 | 11 | 60 | 2400.1 | 2868.1 | 0.2 | 6.3 | 33.6 | 30 | 51 |
| 101 | 10 | 18 | 2 | 1 | 64 | 4 | 1 | 0.9 | 17 | 1004 | 0 | 251 | 0 | 0 | 70.1 | 1562.1 | 0 | 0 | 3 | 247 | 2400.1 | 3153.1 | 0 | -' | 7 | | |
| 101 | 10 | 2 | 3 | 2 | 1 | 256 | 1 | 3.1 | 635 | 0 | 635 | 0 | 1701.4 | 0 | 0 | 0 | 634 | 0 | 0 | 0 | 2400.1 | 4305.1 | 49.9 | 0 | 23.4 | 0.1 | 0 |
| 101 | 10 | 4 | 3 | 2 | 8 | 32 | 2 | 1.6 | 2072 | 28 | 259 | 0 | 1434 | 0 | 0 | 0 | 258 | 0 | 0 | 0 | 2400.1 | 3177.1 | 57.7 | 0 | 35.3 | 0.1 | 1 |
| 101 | 10 | 6 | 3 | 2 | 128 | 2 | 1 | 14.2 | 63 | 904 | 0 | 452 | 0 | 0 | 0 | 2046.2 | 0 | 0 | 0 | 451 | 2400.1 | 3756.1 | 0 | 120.2 | 1 | 45.2 | 1 |
| 101 | 10 | 8 | 3 | 2 | 4 | 64 | 2 | 0.8 | 468 | 227 | 117 | 3 | 641.7 | 1092.4 | 0 | 8.1 | 88 | 28 | 0 | 3 | 2400.1 | 2760.1 | 8.3 | 0.2 | 8.8 | 0.2 | 57 |
| 101 | 10 | 10 | 3 | 2 | 256 | 1 | 1 | 1.8 | 1 | 342 | 0 | 342 | 0 | 0 | 0 | 2179.2 | 0 | 0 | 0 | 341 | 2400.1 | 3426.1 | 0 | 55.8 | 0.9 | 30 | 1 |
| 101 | 10 | 12 | 3 | 2 | 32 | 8 | 1 | 1.1 | 126 | 1857 | 3 | 232 | 2.5 | 6.2 | 195.4 | 1193 | 1 | 2 | 16 | 216 | 2400.1 | 3105.1 | 0 | 14.3 | 0 | 15.3 | 43 |
| 101 | 10 | 15 | 3 | 2 | 2 | 128 | 2 | 1.3 | 948 | 241 | 474 | 1 | 1424.4 | 302 | 0 | 3.5 | 415 | 58 | 0 | 1 | 2400.1 | 3825.1 | 20 | 0.2 | 22.4 | 0 | 121 |
| 101 | 10 | 17 | 3 | 2 | 16 | 16 | 2 | 1.4 | 2811 | 294 | 175 | 18 | 928.5 | 94.4 | 60.1 | 33.7 | 163 | 12 | 11 | 7 | 2400.1 | 2979.1 | 36.6 | 6.1 | 24 | 2.3 | 35 |
| 101 | 10 | 19 | 3 | 2 | 64 | 4 | 2 | 2.7 | 21 | 2128 | 0 | 532 | 0 | 0 | 5.2 | 1445.3 | 0 | 0 | 2 | 529 | 2400.1 | 3996.1 | 0 | 109.8 | -0.1 | 46.8 | 4 |
| 101 | 10 | 3 | 4 | 3 | 1 | 256 | 2 | 1.9 | 232 | 443 | 232 | 1 | 347.6 | 258.2 | 0 | 2.5 | 219 | 13 | 0 | 1 | 2400.1 | 3099.1 | 6.8 | 0.1 | 115.9 | 0 | 26 |
| 101 | 10 | 6 | 4 | 3 | 8 | 32 | 1 | 2.5 | 1064 | 1186 | 133 | 37 | 262.6 | 98.3 | 23.5 | 533.4 | 126 | 7 | 2 | 35 | 2400.1 | 2910.1 | 6.3 | 15.1 | 77.7 | 6.5 | 17 |
| 101 | 10 | 8 | 4 | 3 | 128 | 2 | 1 | 0.8 | 792 | 824 | 6 | 412 | 35 | 37.7 | 336 | 1197.7 | 3 | 3 | 18 | 394 | 2400.1 | 3654.1 | 1 | 77.6 | 6.3 | 34.6 | 38 |
| 101 | 10 | 12 | 4 | 3 | 4 | 64 | 2 | 1.9 | 1076 | 985 | 269 | 15 | 505.6 | 15.9 | 0 | 330.2 | 265 | 4 | 0 | 15 | 2400.1 | 3252.1 | 8.4 | 6.8 | 137.4 | 2.7 | 8 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 10 | 14 | 4 | 3 | 256 | 1 | 2 | 6.9 | 2 | 685 | 0 | 685 | 0 | 0 | 8.7 | 2270.8 | 0 | 0 | 1 | 683 | 2400.1 | 4455.1 | 0 | 193.2 | 0.6 | 52.4 | 2 |
| 101 | 10 | 16 | 4 | 3 | 32 | 8 | 1 | 2.5 | 6 | 2200 | 0 | 275 | 0 | 0 | 0 | 1300.4 | 0 | 0 | 0 | 274 | 2400.1 | 3225.1 | 0 | 72.2 | 0.4 | 29.5 | 1 |
| 101 | 10 | 19 | 4 | 3 | 2 | 128 | 1 | 2.6 | 270 | 854 | 135 | 6 | 293.5 | 142.1 | 0 | 134.7 | 123 | 12 | 0 | 6 | 2400.1 | 2823.1 | 0.4 | 2.3 | 44.2 | 1.1 | 23 |
| 101 | 10 | 21 | 4 | 3 | 16 | 16 | 1 | 1.2 | 875 | 1296 | 54 | 81 | 182.2 | 82.1 | 131.9 | 481.9 | 39 | 15 | 17 | 64 | 2400.1 | 2805.1 | 0 | 28.6 | 29.8 | 11.2 | 56 |
| 101 | 10 | 23 | 4 | 3 | 64 | 4 | 2 | 1.8 | 8 | 1758 | 0 | 439 | 0 | 0 | 65.5 | 1444.2 | 0 | 0 | 3 | 436 | 2400.1 | 3717.1 | 0 | 153.8 | 0.9 | 49.7 | 6 |
| 102 | 10 | 1 | 2 | 1 | 1 | 256 | 1 | 2.9 | 114 | 0 | 114 | 0 | 2359.4 | 0 | 0 | 0 | 113 | 0 | 0 | 0 | 2400.1 | 2742.1 | 20.5 | 0 | 17.4 | 2.5 | 0 |
| 102 | 10 | 3 | 2 | 1 | 8 | 32 | 2 | 3.4 | 464 | 32 | 58 | 1 | 1050 | 0 | 4.6 | 0 | 57 | 0 | 1 | 0 | 2400.1 | 2577.1 | 28.5 | 1.1 | 54.7 | 4.6 | 1 |
| 102 | 10 | 5 | 2 | 1 | 128 | 2 | 2 | 4.9 | 27 | 217 | 0 | 108 | 0 | 0 | 5.4 | 2289.8 | 0 | 0 | 2 | 106 | 2400.1 | 2724.1 | 0 | 35.9 | 3.6 | 60.2 | 4 |
| 102 | 10 | 8 | 2 | 1 | 4 | 64 | 1 | 2.2 | 474 | 51 | 118 | 0 | 1268.6 | 18.7 | 0 | 0 | 117 | 1 | 0 | 0 | 2400.1 | 2754.1 | 16.6 | 0 | 50.6 | 1.3 | 2 |
| 102 | 10 | 10 | 2 | 1 | 256 | 1 | 1 | 2.5 | 33 | 212 | 0 | 212 | 0 | 0 | 97.6 | 700.5 | 0 | 0 | 3 | 208 | 2400.1 | 3036.1 | 0 | 54 | 2.8 | 60.7 | 7 |
| 102 | 10 | 12 | 2 | 1 | 32 | 8 | 2 | 2.1 | 87 | 1080 | 2 | 135 | 1.2 | 2.5 | 10.6 | 948.2 | 1 | 1 | 7 | 127 | 2400.1 | 2811.1 | 0.6 | 64.4 | 2.5 | 99.4 | 14 |
| 102 | 10 | 14 | 2 | 1 | 2 | 128 | 1 | 1.8 | 348 | 0 | 174 | 0 | 214.3 | 0 | 0 | 0 | 173 | 0 | 0 | 0 | 2400.1 | 2922.1 | 12 | 0 | 64.6 | 1.7 | 0 |
| 102 | 10 | 16 | 2 | 1 | 16 | 16 | 1 | 1.2 | 944 | 272 | 59 | 17 | 706.7 | 18.2 | 40.4 | 21 | 55 | 3 | 10 | 7 | 2400.1 | 2628.1 | 26.4 | 11.6 | 76.5 | 24.1 | 20 |
| 102 | 10 | 18 | 2 | 1 | 64 | 4 | 1 | 1.2 | 17 | 816 | 0 | 204 | 0 | 0 | 1 | 673.3 | 0 | 0 | 1 | 202 | 2400.1 | 3012.1 | 0 | 47.3 | 2.1 | 80.9 | 3 |
| 102 | 10 | 2 | 3 | 2 | 1 | 256 | 1 | 2.6 | 332 | 0 | 332 | 0 | 1801.8 | 0 | 0 | 0 | 331 | 0 | 0 | 0 | 2400.1 | 3396.1 | 36.2 | 0 | 22.1 | 0 | 0 |
| 102 | 10 | 4 | 3 | 2 | 8 | 32 | 2 | 1.9 | 832 | 87 | 104 | 2 | 731.3 | 735.9 | 0 | 3.3 | 92 | 11 | 0 | 2 | 2400.1 | 2718.1 | 28 | 0.4 | 11.6 | 0.4 | 25 |
| 102 | 10 | 6 | 3 | 2 | 128 | 2 | 1 | 2.8 | 52 | 272 | 0 | 136 | 0 | 0 | 13.8 | 990.8 | 0 | 0 | 3 | 132 | 2400.1 | 2808.1 | 0 | 24.4 | 1.5 | 9.4 | 7 |
| 102 | 10 | 8 | 3 | 2 | 4 | 64 | 2 | 3.5 | 740 | 8 | 185 | 0 | 1921.9 | 118 | 0 | 0 | 182 | 2 | 0 | 0 | 2400.1 | 2955.1 | 34.2 | 0 | 17.9 | 0 | 5 |
| 102 | 10 | 10 | 3 | 2 | 256 | 1 | 1 | 4.4 | 25 | 800 | 0 | 800 | 0 | 0 | 0 | 2185 | 0 | 0 | 0 | 799 | 2400.1 | 4800.1 | 0 | 150.3 | 0 | 54.3 | 1 |
| 102 | 10 | 12 | 3 | 2 | 32 | 8 | 1 | 2.9 | 4 | 1584 | 0 | 198 | 0 | 0 | 0 | 1422.5 | 0 | 0 | 0 | 197 | 2400.1 | 2994.1 | 0 | 121.8 | 0.2 | 37.6 | 1 |
| 102 | 10 | 15 | 3 | 2 | 2 | 128 | 2 | 1.9 | 900 | 28 | 450 | 0 | 1787.6 | 41.8 | 0 | 0 | 448 | 1 | 0 | 0 | 2400.1 | 3750.1 | 83.7 | 0 | 53.2 | 0.2 | 3 |
| 102 | 10 | 17 | 3 | 2 | 16 | 16 | 2 | 2.1 | 2454 | 111 | 153 | 6 | 889.9 | 19.4 | 6.2 | 9.7 | 149 | 4 | 2 | 4 | 2400.1 | 2877.1 | 87.7 | 4.3 | 32.6 | 1.9 | 43 |
| 102 | 10 | 19 | 3 | **2** | **64** | 4 | 1 | 2.3 | 21 | 884 | 0 | 221 | 0 | 0 | 22.7 | 1333.9 | 0 | 0 | 3 | 217 | 2400.1 | 3063.1 | 0 | 80.6 | 0.3 | 25.7 | 7 |
| 102 | 10 | 3 | 4 | **3** | **1** | 256 | 2 | 5.3 | 138 | 1 | 138 | 0 | 2362.5 | 0 | 0 | 0 | 137 | 0 | 0 | 0 | 2400.1 | 2814.1 | 8.3 | 0 | 56.3 | 0.2 | 1 |
| 102 | 10 | 6 | 4 | **3** | **8** | 32 | 1 | 2.3 | 732 | 0 | 91 | 0 | 1852.2 | 0 | 0 | 0 | 91 | 0 | 0 | 0 | 2400.1 | 2673.1 | 42.8 | 0 | 145.1 | 1.3 | 0 |

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| 102 | 10 | 8 | 4 | **3** | **128** | 2 | 1 | 4.6 | 1596 | 358 | 12 | 179 | 77.7 | 0 | 182.5 | 214.7 | 12 | 0 | 43 | 135 | 2400.1 | 2973.1 | 8.2 | 65.8 | 30.5 | 22.9 | 89 |
| 102 | 10 | 12 | 4 | **3** | **4** | 64 | 1 | 1.4 | 652 | 11 | 163 | 0 | 1673.8 | 240.9 | 0 | 0 | 161 | 1 | 0 | 0 | 2400.1 | 2889.1 | 46.6 | 0 | 152 | 0 | 2 |
| 102 | 10 | 14 | 4 | **3** | **256** | 1 | 1 | 5.2 | 234 | 545 | 0 | 545 | 0 | 0 | 621.8 | 847.6 | 0 | 0 | 63 | 481 | 2400.1 | 4035.1 | 0 | 141.7 | 3 | 47.8 | 127 |
| 102 | 10 | 16 | 4 | **3** | **32** | 8 | 1 | 3.6 | 1600 | 544 | 50 | 68 | 412.2 | 26.7 | 60.1 | 208.9 | 47 | 2 | 15 | 53 | 2400.1 | 2754.1 | 20.5 | 43.5 | 81.3 | 11.7 | 30 |
| 102 | 10 | 19 | 4 | **3** | **2** | 128 | 1 | 2.6 | 660 | 1 | 330 | 0 | 1259.2 | 45.6 | 0 | 0 | 328 | 1 | 0 | 0 | 2400.1 | 3390.1 | 54.2 | 0 | 222.5 | 0.2 | 2 |
| 102 | 10 | 21 | 4 | **3** | **16** | 16 | 1 | 2 | 1168 | 0 | 73 | 0 | 1227.4 | 0 | 0 | 0 | 72 | 0 | 0 | 0 | 2400.1 | 2619.1 | 6.5 | 0 | 123.3 | 0.2 | 0 |
| 102 | 10 | 23 | 4 | **3** | **64** | 4 | 1 | 3.2 | 1555 | 572 | 24 | 143 | 202.3 | 0 | 86.5 | 312.9 | 24 | 0 | 16 | 127 | 2400.1 | 2901.1 | 12.9 | 66.1 | 50 | 20.3 | 34 |
| 103 | 10 | 1 | 2 | **1** | **1** | 256 | 2 | 12.7 | 53 | 25 | 53 | 0 | 1359.6 | 35.4 | 0 | 0 | 51 | 1 | 0 | 0 | 2400.1 | 2559.1 | 16.3 | 0 | 31.9 | 2 | 3 |
| 103 | 10 | 3 | 2 | **1** | **8** | 32 | 2 | 8.7 | 229 | 41 | 28 | 1 | 151.4 | 0 | 0 | 5.2 | 28 | 0 | 0 | 1 | 2400.1 | 2487.1 | 10.3 | 0 | 41.9 | 2.4 | 2 |
| 103 | 10 | 5 | 2 | **1** | **128** | 2 | 2 | 10.4 | 119 | 92 | 0 | 46 | 0 | 0 | 8.8 | 633.2 | 0 | 0 | 1 | 44 | 2400.1 | 2538.1 | 0 | 17.5 | 2.2 | 62.5 | 4 |
| 103 | 10 | 8 | 2 | **1** | **4** | 64 | 2 | 5 | 194 | 153 | 48 | 2 | 255.1 | 150.3 | 0 | 14.8 | 47 | 1 | 0 | 2 | 2400.1 | 2550.1 | 16.4 | 0.7 | 71 | 3.6 | 4 |
| 103 | 10 | 10 | 2 | **1** | **256** | 1 | 1 | 6.3 | 43 | 108 | 0 | 108 | 0 | 0 | 0 | 522.4 | 0 | 0 | 0 | 107 | 2400.1 | 2724.1 | 0 | 41.1 | 2.1 | 124 | 1 |
| 103 | 10 | 12 | 2 | **1** | **32** | 8 | 1 | 7.5 | 80 | 384 | 2 | 48 | 26.6 | 0 | 34.8 | 544.9 | 2 | 0 | 1 | 46 | 2400.1 | 2550.1 | 0.8 | 22.2 | 5.5 | 66.4 | 3 |
| 103 | 10 | 14 | 2 | **1** | **2** | 128 | 2 | 7.3 | 112 | 44 | 56 | 0 | 286.4 | 0 | 0 | 0 | 55 | 0 | 0 | 0 | 2400.1 | 2568.1 | 15.3 | 0 | 79.7 | 1.4 | 1 |
| 103 | 10 | 16 | 2 | **1** | **16** | 16 | 2 | 8 | 170 | 23 | 10 | 1 | 422.1 | 0 | 0 | 3.9 | 10 | 0 | 0 | 1 | 2400.1 | 2433.1 | 4.6 | 0.3 | 20 | 3.3 | 4 |
| 103 | 10 | 18 | 2 | **1** | **64** | 4 | 1 | 9.1 | 2 | 344 | 0 | 86 | 0 | 0 | 0 | 679.8 | 0 | 0 | 0 | 85 | 2400.1 | 2658.1 | 0 | 29.2 | 1.9 | 82.4 | 1 |
| 103 | 10 | 15 | 3 | **2** | **2** | 128 | 2 | 13.6 | 224 | 110 | 112 | 0 | 590 | 897.1 | 0 | 0 | 111 | 1 | 0 | 0 | 2400.1 | 2736.1 | 32.7 | 0 | 17 | 0.3 | 2 |
| 103 | 10 | 17 | 3 | **2** | **16** | 16 | 1 | 5.1 | 440 | 328 | 27 | 20 | 255.5 | 83.1 | 104.3 | 141.4 | 23 | 4 | 5 | 15 | 2400.1 | 2541.1 | 11.6 | 10.4 | 4.8 | 4.4 | 28 |
| 103 | 10 | 19 | 3 | **2** | **64** | 4 | 2 | 28.4 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2400.1 | 2400.1 | 0 | 0 | 1.1 | 0.1 | 0 |
| 103 | 10 | 3 | 4 | **3** | **1** | 256 | 2 | 7.8 | 111 | 2 | 111 | 0 | 769.2 | 0 | 0 | 0 | 110 | 0 | 0 | 0 | 2400.1 | 2733.1 | 21.2 | 0 | 119.9 | 0.3 | 1 |
| 103 | 10 | 6 | 4 | 3 | 8 | 32 | 2 | 4.1 | 314 | 11 | 39 | 0 | 315.9 | 41 | 0 | 0 | 38 | 1 | 0 | 0 | 2400.1 | 2517.1 | 15.5 | 0 | 68.9 | 0.1 | 5 |
| 103 | 10 | 8 | 4 | 3 | 128 | 2 | 1 | 11.6 | 243 | 88 | 1 | 44 | 9.3 | 0 | 52.3 | 600.6 | 1 | 0 | 3 | 40 | 2400.1 | 2535.1 | 0.6 | 15.6 | 3.9 | 6.7 | 7 |
| 103 | 10 | 12 | 4 | 3 | 4 | 64 | 1 | 5.6 | 252 | 1 | 63 | 0 | 498.4 | 0 | 0 | 0 | 62 | 0 | 0 | 0 | 2400.1 | 2589.1 | 21.2 | 0 | 94.9 | -0.1 | 2 |
| 103 | 10 | 14 | 4 | 3 | 256 | 1 | 1 | 6.7 | 101 | 19 | 0 | 19 | 0 | 0 | 66.8 | 88.8 | 0 | 0 | 2 | 16 | 2400.1 | 2457.1 | 0 | 1.5 | 1.7 | 1.1 | 5 |
| 103 | 10 | 16 | 4 | 3 | 32 | 8 | 1 | 9.1 | 320 | 80 | 10 | 10 | 124 | 88.8 | 36.7 | 31.8 | 7 | 3 | 2 | 7 | 2400.1 | 2460.1 | 4.8 | 2.5 | 20.4 | 1 | 5 |

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| 103 | 10 | 21 | 4 | 3 | 16 | 16 | 1 | 8.6 | 484 | 0 | 30 | 0 | 423.5 | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 2400.1 | 2490.1 | 0.6 | 0 | 63.6 | 0.2 | 0 |
| 103 | 10 | 23 | 4 | 3 | 64 | 4 | 1 | 21.5 | 514 | 137 | 8 | 34 | 157.1 | 0 | 500 | 291.8 | 8 | 0 | 3 | 31 | 2400.1 | 2526.1 | 2.5 | 17.4 | 12.5 | 5 | 16 |
| 104 | 10 | 2 | 2 | 1 | 1 | 256 | 1 | 5.4 | 166 | 0 | 166 | 0 | 2030.4 | 0 | 0 | 0 | 165 | 0 | 0 | 0 | 2400.1 | 2898.1 | 44.8 | 0 | 174.4 | 0.9 | 0 |
| 104 | 10 | 4 | 2 | 1 | 8 | 32 | 1 | 8.1 | 400 | 0 | 50 | 0 | 383.2 | 0 | 0 | 0 | 49 | 0 | 0 | 0 | 2400.1 | 2550.1 | 7.9 | 0 | 46.7 | -0.1 | 0 |
| 104 | 10 | 6 | 2 | 1 | 128 | 2 | 1 | 4.1 | 94 | 112 | 0 | 56 | 0 | 0 | 116.8 | 233.1 | 0 | 0 | 2 | 53 | 2400.1 | 2568.1 | 0 | 20.3 | 2.2 | 55.2 | 5 |
| 104 | 10 | 9 | 2 | 1 | 4 | 64 | 2 | 4.5 | 40 | 52 | 10 | 0 | 31.5 | 1375.9 | 0 | 0 | 8 | 2 | 0 | 0 | 2400.1 | 2430.1 | 3.9 | 0 | 13.7 | 1 | 4 |
| 104 | 10 | 11 | 2 | 1 | 256 | 1 | 1 | 2.7 | 26 | 145 | 0 | 145 | 0 | 0 | 0 | 1941.9 | 0 | 0 | 0 | 144 | 2400.1 | 2835.1 | 0 | 37.5 | 1.2 | 111 | 1 |
| 104 | 10 | 13 | 2 | 1 | 32 | 8 | 1 | 4.9 | 29 | 589 | 0 | 73 | 0 | 0 | 144 | 610.1 | 0 | 0 | 3 | 70 | 2400.1 | 2619.1 | 0 | 17.2 | 1.8 | 53.9 | 7 |
| 104 | 10 | 15 | 2 | 1 | 2 | 128 | 1 | 4.9 | 234 | 3 | 117 | 0 | 637.3 | 357 | 0 | 0 | 116 | 1 | 0 | 0 | 2400.1 | 2751.1 | 29.3 | 0 | 120.1 | 1.9 | 1 |
| 104 | 10 | 17 | 2 | 1 | 16 | 16 | 1 | 4.1 | 800 | 928 | 50 | 58 | 333.2 | 107.8 | 265 | 346.4 | 41 | 8 | 23 | 35 | 2400.1 | 2724.1 | 16.1 | 20.9 | 60.6 | 55.9 | 62 |
| 104 | 10 | 19 | 2 | 1 | 64 | 4 | 2 | 2.3 | 20 | 688 | 0 | 172 | 0 | 0 | 5.4 | 1463.1 | 0 | 0 | 1 | 170 | 2400.1 | 2916.1 | 0 | 65.3 | 1.3 | 171.5 | 2 |
| 104 | 10 | 1 | 3 | 2 | 1 | 256 | 1 | 8.6 | 380 | 0 | 380 | 0 | 2348.9 | 0 | 0 | 0 | 379 | 0 | 0 | 0 | 2400.1 | 3540.1 | 99.8 | 0 | 56.9 | -0.2 | 0 |
| 104 | 10 | 3 | 3 | 2 | 8 | 32 | 1 | 4.4 | 2336 | 0 | 292 | 0 | 1387 | 0 | 0 | 0 | 291 | 0 | 0 | 0 | 2400.1 | 3276.1 | 117.8 | 0 | 53.7 | -0.1 | 0 |
| 104 | 10 | 5 | 3 | 2 | 128 | 2 | 2 | 6.6 | 0 | 698 | 0 | 349 | 0 | 0 | 0 | 1720.9 | 0 | 0 | 0 | 348 | 2400.1 | 3447.1 | 0 | 145 | 2.1 | 18.4 | 0 |
| 104 | 10 | 7 | 3 | 2 | 4 | 64 | 1 | 4 | 1408 | 18 | 352 | 0 | 1610.6 | 81.5 | 0 | 0 | 348 | 3 | 0 | 0 | 2400.1 | 3456.1 | 120.6 | 0 | 30.9 | -0.1 | 6 |
| 104 | 10 | 9 | 3 | 2 | 256 | 1 | 1 | 3.3 | 8 | 504 | 0 | 504 | 0 | 0 | 0 | 2108.6 | 0 | 0 | 0 | 503 | 2400.1 | 3912.1 | 0 | 156.4 | 1.4 | 23.6 | 1 |
| 104 | 10 | 11 | 3 | 2 | 32 | 8 | 1 | 3.3 | 17 | 2472 | 0 | 309 | 0 | 0 | 33.5 | 1282.3 | 0 | 0 | 8 | 300 | 2400.1 | 3327.1 | 0 | 143.3 | -0.7 | 56.5 | 17 |
| 104 | 10 | 13 | 3 | 2 | 2 | 128 | 1 | 2.8 | 966 | 4 | 483 | 0 | 1722.4 | 118.5 | 0 | 0 | 480 | 2 | 0 | 0 | 2400.1 | 3849.1 | 155.7 | 0 | 75.6 | 0 | 4 |
| 104 | 10 | 16 | 3 | 2 | 16 | 16 | 1 | 5.2 | 568 | 1552 | 35 | 97 | 115.6 | 69.4 | 153.6 | 576.7 | 26 | 9 | 16 | 80 | 2400.1 | 2796.1 | 7.3 | 45.8 | 4.5 | 19.8 | 45 |
| 104 | 10 | 18 | 3 | 2 | 64 | 4 | 1 | 2.3 | 7 | 1331 | 0 | 332 | 0 | 0 | 12.8 | 1769.2 | 0 | 0 | 1 | 331 | 2400.1 | 3396.1 | 0 | 136.7 | 0.7 | 54.2 | 3 |
| 104 | 10 | 5 | 4 | 3 | 1 | 256 | 2 | 2.4 | 202 | 13 | 202 | 0 | 1252.8 | 352.7 | 0 | 0 | 200 | 2 | 0 | 0 | 2400.1 | 3006.1 | 61.9 | 0 | 232.9 | 0 | 4 |
| 104 | 10 | 7 | 4 | 3 | 8 | 32 | 1 | 6.5 | 784 | 29 | 98 | 0 | 606 | 517.2 | 0 | 0 | 97 | 1 | 0 | 0 | 2400.1 | 2694.1 | 28.5 | 0 | 127.9 | 0.1 | 1 |
| 104 | 10 | 9 | 4 | 3 | 128 | 2 | 1 | 7.2 | 1227 | 499 | 9 | 249 | 62.4 | 0 | 144.1 | 716.8 | 9 | 0 | 8 | 241 | 2400.1 | 3174.1 | 1.4 | 92.2 | 10.9 | 36.1 | 17 |
| 104 | 10 | 13 | 4 | 3 | 4 | 64 | 1 | 4.7 | 428 | 0 | 107 | 0 | 882.6 | 0 | 0 | 0 | 106 | 0 | 0 | 0 | 2400.1 | 2721.1 | 23.8 | 0 | 138.6 | -0.2 | 0 |
| 104 | 10 | 15 | 4 | 3 | 256 | 1 | 1 | 3.5 | 92 | 212 | 0 | 212 | 0 | 0 | 47.5 | 1805.2 | 0 | 0 | 4 | 207 | 2400.1 | 3036.1 | 0 | 66.1 | 1.8 | 29.4 | 9 |

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| 104 | 10 | 17 | 4 | 3 | 32 | 8 | 1 | 4 | 67 | 1968 | 2 | 246 | 7.6 | 0 | 3.7 | 1367.2 | 2 | 0 | 1 | 244 | 2400.1 | 3144.1 | 0.8 | 86.5 | 6.6 | 36.2 | 3 |
| 104 | 10 | 20 | 4 | 3 | 2 | 128 | 1 | 2.9 | 222 | 0 | 111 | 0 | 654 | 0 | 0 | 0 | 110 | 0 | 0 | 0 | 2400.1 | 2733.1 | 0 | 0 | 129.3 | 0 | 0 |
| 104 | 10 | 22 | 4 | 3 | 16 | 16 | 1 | 2.7 | 1875 | 104 | 117 | 6 | 836.5 | 17.1 | 11.4 | 10.4 | 115 | 2 | 3 | 3 | 2400.1 | 2769.1 | 15.8 | 1.5 | 131.4 | 0.2 | 16 |
| 104 | 10 | 24 | 4 | 3 | 64 | 4 | 1 | 1.6 | 1988 | 100 | 31 | 25 | 304.5 | 24.7 | 20.2 | 85.4 | 29 | 2 | 6 | 18 | 2400.1 | 2568.1 | 3 | 2.3 | 86.4 | 1.6 | 19 |
| 105 | 10 | 2 | 2 | 1 | 1 | 256 | 2 | 6.6 | 134 | 63 | 134 | 0 | 1474.4 | 0 | 0 | 0 | 133 | 0 | 0 | 0 | 2400.1 | 2802.1 | 18.8 | 0 | 100 | 1 | 1 |
| 105 | 10 | 4 | 2 | 1 | 8 | 32 | 1 | 4.2 | 240 | 0 | 30 | 0 | 955.4 | 0 | 0 | 0 | 29 | 0 | 0 | 0 | 2400.1 | 2490.1 | 0.1 | 0 | 8.5 | 0.3 | 0 |
| 105 | 10 | 6 | 2 | 1 | 128 | 2 | 2 | 3.6 | 137 | 360 | 1 | 180 | 3.6 | 0 | 39 | 1319.8 | 1 | 0 | 3 | 176 | 2400.1 | 2943.1 | 0.1 | 29.4 | 1.6 | 64.3 | 6 |
| 105 | 10 | 9 | 2 | 1 | 4 | 64 | 2 | 2.4 | 516 | 33 | 129 | 0 | 471.9 | 34.3 | 0 | 0 | 125 | 3 | 0 | 0 | 2400.1 | 2787.1 | 3.7 | 0 | 35.2 | 0.1 | 7 |
| 105 | 10 | 11 | 2 | 1 | 256 | 1 | 1 | 10.1 | 12 | 167 | 0 | 167 | 0 | 0 | 7.2 | 2210.7 | 0 | 0 | 1 | 165 | 2400.1 | 2901.1 | 0 | 21.4 | 0.9 | 31.8 | 3 |
| 105 | 10 | 13 | 2 | 1 | 32 | 8 | 1 | 2.7 | 62 | 568 | 1 | 71 | 2.5 | 0 | 847.8 | 322.1 | 1 | 0 | 1 | 69 | 2400.1 | 2616.1 | 0.3 | 8.6 | -0.1 | 23 | 3 |
| 105 | 10 | 15 | 2 | 1 | 2 | 128 | 2 | 3 | 158 | 129 | 79 | 1 | 754.8 | 0 | 0 | 6.3 | 78 | 0 | 0 | 1 | 2400.1 | 2640.1 | 2.3 | 0 | 32.8 | 0.3 | 1 |
| 105 | 10 | 17 | 2 | 1 | 16 | 16 | 2 | 1.6 | 1536 | 48 | 96 | 3 | 555.7 | 13.1 | 16.1 | 0 | 93 | 2 | 3 | 0 | 2400.1 | 2697.1 | 24.3 | 1 | 83.7 | 3.4 | 5 |
| 105 | 10 | 19 | 2 | 1 | 64 | 4 | 1 | 4.1 | 195 | 524 | 3 | 131 | 13.5 | 0 | 1064.9 | 475.5 | 3 | 0 | 1 | 129 | 2400.1 | 2802.1 | 0 | 12.7 | 1.4 | 45.9 | 3 |
| 105 | 10 | 1 | 3 | 2 | 1 | 256 | 1 | 6.1 | 516 | 153 | 516 | 0 | 2078.3 | 104.2 | 0 | 0 | 512 | 3 | 0 | 0 | 2400.1 | 3948.1 | 64.1 | 0 | 37.7 | 0.1 | 6 |
| 105 | 10 | 3 | 3 | 2 | 8 | 32 | 2 | 2.3 | 1697 | 100 | 212 | 3 | 1091.9 | 6.9 | 295 | 7.4 | 211 | 1 | 1 | 2 | 2400.1 | 3045.1 | 44.5 | 0.7 | 25 | 0.5 | 7 |
| 105 | 10 | 5 | 3 | 2 | 128 | 2 | 2 | 3 | 259 | 847 | 2 | 423 | 10.2 | 0 | 33.2 | 1832.5 | 2 | 0 | 2 | 421 | 2400.1 | 3675.1 | 0.2 | 66.3 | 0.3 | 33.3 | 4 |
| 105 | 10 | 7 | 3 | 2 | 4 | 64 | 1 | 5.3 | 964 | 18 | 241 | 0 | 1418.3 | 249.3 | 0 | 0 | 236 | 4 | 0 | 0 | 2400.1 | 3123.1 | 30.4 | 0 | 19.8 | 0.1 | 8 |
| 105 | 10 | 9 | 3 | 2 | 256 | 1 | 1 | 3.4 | 42 | 132 | 0 | 132 | 0 | 0 | 52.4 | 1921.8 | 0 | 0 | 1 | 131 | 2400.1 | 2796.1 | 0 | 10.8 | -5.1 | 9.6 | 2 |
| 105 | 10 | 11 | 3 | 2 | 32 | 8 | 1 | 2 | 81 | 1768 | 2 | 221 | 5.9 | 0 | 38.9 | 1309.4 | 2 | 0 | 1 | 219 | 2400.1 | 3069.1 | 0.6 | 39.5 | 0.2 | 21.8 | 5 |
| 105 | 10 | 13 | 3 | 2 | 2 | 128 | 2 | 3.1 | 602 | 91 | 301 | 0 | 1835.3 | 170.8 | 0 | 0 | 297 | 3 | 0 | 0 | 2400.1 | 3303.1 | 30.7 | 0 | 21.5 | 0.1 | 7 |
| 105 | 10 | 16 | 3 | 2 | 16 | 16 | 1 | 2.5 | 336 | 1265 | 21 | 79 | 79.5 | 52.3 | 10 | 844.9 | 15 | 6 | 2 | 77 | 2400.1 | 2700.1 | 5 | 24.6 | 2.8 | 10.5 | 13 |
| 105 | 10 | 18 | 3 | 2 | 64 | 4 | 1 | 2.1 | 10 | 1030 | 0 | 257 | 0 | 0 | 45.1 | 1576.4 | 0 | 0 | 1 | 256 | 2400.1 | 3171.1 | 0 | 45.7 | -0.5 | 21.6 | 3 |
| 105 | 10 | 5 | 4 | 3 | 1 | 256 | 1 | 3.3 | 132 | 24 | 132 | 0 | 361.4 | 1177.7 | 0 | 0 | 128 | 3 | 0 | 0 | 2400.1 | 2796.1 | 12.7 | 0 | 75.7 | 0 | 6 |
| 105 | 10 | 7 | 4 | 3 | 8 | 32 | 1 | 3 | 905 | 30 | 113 | 0 | 736.9 | 1292.3 | 0 | 0 | 111 | 2 | 0 | 0 | 2400.1 | 2739.1 | 10.8 | 0 | 65.5 | 0.2 | 4 |
| 105 | 10 | 9 | 4 | 3 | 128 | 2 | 1 | 4.6 | 1487 | 482 | 11 | 241 | 80 | 21.9 | 722.2 | 399.6 | 9 | 2 | 14 | 227 | 2400.1 | 3156.1 | 1.6 | 53 | 9.4 | 20 | 28 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 105 | 10 | 13 | 4 | 3 | 4 | 64 | 1 | 2.2 | 576 | 12 | 144 | 0 | 1510.9 | 10.6 | 0 | 0 | 142 | 1 | 0 | 0 | 2400.1 | 2832.1 | 20.4 | 0 | 106.3 | 0.1 | 2 |
| 105 | 10 | 15 | 4 | 3 | 256 | 1 | 1 | 2.6 | 95 | 67 | 0 | 67 | 0 | 0 | 27 | 137.8 | 0 | 0 | 4 | 62 | 2400.1 | 2601.1 | 0 | 19.7 | 1.9 | 6.9 | 9 |
| 105 | 10 | 17 | 4 | 3 | 32 | 8 | 1 | 2.5 | 1898 | 354 | 59 | 44 | 448.3 | 57.8 | 47.4 | 110.9 | 52 | 7 | 9 | 35 | 2400.1 | 2709.1 | 14.9 | 8.7 | 59.9 | 4.8 | 19 |
| 105 | 10 | 20 | 4 | 3 | 2 | 128 | 1 | 2.8 | 216 | 216 | 108 | 1 | 278.9 | 1054.4 | 3.4 | 0 | 102 | 6 | 1 | 0 | 2400.1 | 2727.1 | 0 | 0.3 | 39.2 | 0.3 | 11 |
| 105 | 10 | 22 | 4 | 3 | 16 | 16 | 1 | 1.8 | 1488 | 26 | 93 | 1 | 1749.7 | 13.6 | 2.7 | 0 | 89 | 3 | 1 | 0 | 2400.1 | 2682.1 | 18.6 | 0.5 | 73.8 | 0.2 | 6 |
| 105 | 10 | 24 | 4 | 3 | 64 | 4 | 1 | 2.2 | 1216 | 264 | 19 | 66 | 362.7 | 142.7 | 54.6 | 769.3 | 18 | 1 | 3 | 62 | 2400.1 | 2655.1 | 3.5 | 7.7 | 19.1 | 5 | 7 |
| 106 | 10 | 2 | 2 | 1 | 1 | 256 | 2 | 6.7 | 190 | 61 | 190 | 0 | 2040.1 | 0 | 0 | 0 | 189 | 0 | 0 | 0 | 2400.1 | 2970.1 | 26.7 | 0 | 171.7 | 2.2 | 1 |
| 106 | 10 | 4 | 2 | 1 | 8 | 32 | 1 | 3.7 | 872 | 67 | 109 | 2 | 599.9 | 258.1 | 12.8 | 5.2 | 107 | 2 | 1 | 1 | 2400.1 | 2733.1 | 23.8 | 0.5 | 118.7 | 3.1 | 5 |
| 106 | 10 | 6 | 2 | 1 | 128 | 2 | 2 | 6.8 | 102 | 314 | 0 | 157 | 0 | 0 | 951.4 | 714.2 | 0 | 0 | 1 | 155 | 2400.1 | 2871.1 | 0 | 39 | 2.2 | 145.7 | 2 |
| 106 | 10 | 9 | 2 | 1 | 4 | 64 | 1 | 6.6 | 568 | 12 | 142 | 0 | 580.3 | 1501.3 | 0 | 0 | 139 | 3 | 0 | 0 | 2400.1 | 2826.1 | 28.5 | 0 | 141.5 | 1.7 | 5 |
| 106 | 10 | 11 | 2 | 1 | 256 | 1 | 1 | 11.2 | 29 | 179 | 0 | 179 | 0 | 0 | 0 | 1539.4 | 0 | 0 | 0 | 178 | 2400.1 | 2937.1 | 0 | 34.7 | 1.5 | 139.2 | 1 |
| 106 | 10 | 13 | 2 | 1 | 32 | 8 | 1 | 2.4 | 15 | 776 | 0 | 97 | 0 | 0 | 23.4 | 632.6 | 0 | 0 | 1 | 95 | 2400.1 | 2691.1 | 0 | 35.6 | 1 | 126 | 3 |
| 106 | 10 | 15 | 2 | 1 | 2 | 128 | 2 | 6.4 | 338 | 14 | 169 | 0 | 1725.8 | 97.1 | 0 | 0 | 167 | 2 | 0 | 0 | 2400.1 | 2907.1 | 25.3 | 0 | 2447 | 2518.2 | 4 |
| 106 | 10 | 17 | 2 | 1 | 16 | 16 | 1 | 2.9 | 290 | 832 | 18 | 52 | 96.7 | 6.3 | 23.6 | 421.3 | 17 | 1 | 3 | 48 | 2400.1 | 2610.1 | 5.3 | 20.1 | 30.1 | 81.2 | 15 |
| 106 | 10 | 19 | 2 | 1 | 64 | 4 | 2 | 5.4 | 9 | 728 | 0 | 182 | 0 | 0 | 45.9 | 1522 | 0 | 0 | 1 | 180 | 2400.1 | 2946.1 | 0 | 51.6 | 1.3 | 141.7 | 2 |
| 106 | 10 | 1 | 3 | 2 | 1 | 256 | 1 | 3.8 | 504 | 41 | 504 | 0 | 1185 | 476.3 | 0 | 0 | 502 | 2 | 0 | 0 | 2400.1 | 3912.1 | 58.6 | 0 | 48 | 0 | 3 |
| 106 | 10 | 3 | 3 | 2 | 8 | 32 | 1 | 4.1 | 2112 | 12 | 264 | 0 | 1312.7 | 98.5 | 0 | 0 | 259 | 4 | 0 | 0 | 2400.1 | 3192.1 | 96.3 | 0 | 47.1 | 0.4 | 8 |
| 106 | 10 | 5 | 3 | 2 | 128 | 2 | 1 | 8.3 | 15 | 840 | 0 | 420 | 0 | 0 | 23.8 | 1586.6 | 0 | 0 | 3 | 416 | 2400.1 | 3660.1 | 0 | 101 | 0.4 | 22.5 | 7 |
| 106 | 10 | 7 | 3 | 2 | 4 | 64 | 1 | 4.5 | 1363 | 8 | 340 | 0 | 1404.9 | 45.1 | 0 | 0 | 338 | 2 | 0 | 0 | 2400.1 | 3420.1 | 93.7 | 0 | 50.9 | 0.3 | 4 |
| 106 | 10 | 9 | 3 | 2 | 256 | 1 | 1 | 7.3 | 4 | 536 | 0 | 536 | 0 | 0 | 23.5 | 2228.3 | 0 | 0 | 1 | 534 | 2400.1 | 4008.1 | 0 | 98.6 | 1.7 | 19.7 | 3 |
| 106 | 10 | 11 | 3 | 2 | 32 | 8 | 1 | 2.5 | 100 | 2112 | 3 | 264 | 12.2 | 0 | 14.2 | 1414.4 | 3 | 0 | 2 | 261 | 2400.1 | 3201.1 | 1.2 | 126 | 0.6 | 56.1 | 5 |
| 106 | 10 | 13 | 3 | 2 | 2 | 128 | 2 | 2.1 | 1106 | 44 | 553 | 0 | 1380.7 | 176.9 | 0 | 0 | 550 | 2 | 0 | 0 | 2400.1 | 4059.1 | 81.7 | 0 | 59.2 | 0.3 | 5 |
| 106 | 10 | 16 | 3 | 2 | 16 | 16 | 2 | 2.3 | 2032 | 271 | 127 | 16 | 923.7 | 38.3 | 8.7 | 111.9 | 123 | 3 | 1 | 15 | 2400.1 | 2829.1 | 53.9 | 8.6 | 27.2 | 4.6 | 33 |
| 106 | 10 | 18 | 3 | 2 | 64 | 4 | 1 | 2.4 | 18 | 1520 | 0 | 380 | 0 | 0 | 25.7 | 1828.3 | 0 | 0 | 2 | 377 | 2400.1 | 3540.1 | 0 | 132.5 | -1 | 58.2 | 5 |
| 106 | 10 | 5 | 4 | 3 | 1 | 256 | 2 | 4.5 | 166 | 2 | 166 | 0 | 623.3 | 0 | 0 | 0 | 165 | 0 | 0 | 0 | 2400.1 | 2898.1 | 44.1 | 0 | 197.8 | 0.6 | 1 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 106 | 10 | 7 | 4 | 3 | 8 | 32 | 1 | 3.4 | 705 | 4 | 88 | 0 | 502.1 | 35.5 | 0 | 0 | 87 | 1 | 0 | 0 | 2400.1 | 2664.1 | 25.5 | 0 | 108.3 | 0.2 | 2 |
| 106 | 10 | 9 | 4 | 3 | 128 | 2 | 1 | 3.2 | 1014 | 742 | 7 | 371 | 119.9 | 0 | 468.5 | 883.4 | 7 | 0 | 8 | 363 | 2400.1 | 3534.1 | 1.8 | 90.3 | 9.3 | 40.6 | 16 |
| 106 | 10 | 13 | 4 | 3 | 4 | 64 | 2 | 2.6 | 440 | 19 | 110 | 0 | 549.4 | 90.4 | 0 | 0 | 108 | 1 | 0 | 0 | 2400.1 | 2730.1 | 24.5 | 0 | 155.4 | 0.2 | 3 |
| 106 | 10 | 15 | 4 | 3 | 256 | 1 | 1 | 5.7 | 99 | 615 | 0 | 615 | 0 | 0 | 63.7 | 2085.8 | 0 | 0 | 4 | 610 | 2400.1 | 4245.1 | 0 | 98.4 | 2.1 | 51.1 | 9 |
| 106 | 10 | 17 | 4 | 3 | 32 | 8 | 1 | 3.9 | 448 | 1640 | 14 | 205 | 155.5 | 17.6 | 78 | 1081.6 | 12 | 1 | 6 | 199 | 2400.1 | 3057.1 | 3 | 84 | 19 | 33.6 | 14 |
| 106 | 10 | 20 | 4 | 3 | 2 | 128 | 1 | 3.5 | 186 | 0 | 93 | 0 | 540.6 | 0 | 0 | 0 | 92 | 0 | 0 | 0 | 2400.1 | 2679.1 | 0 | 0 | 104.5 | 0.2 | 0 |
| 106 | 10 | 22 | 4 | 3 | 16 | 16 | 1 | 3.5 | 1124 | 656 | 70 | 41 | 680.1 | 0 | 0 | 525.8 | 70 | 0 | 0 | 40 | 2400.1 | 2733.1 | 16.6 | 14.5 | 81.9 | 6 | 7 |
| 106 | 10 | 24 | 4 | 3 | 64 | 4 | 1 | 3.8 | 722 | 960 | 11 | 240 | 206.5 | 0 | 67 | 1105.7 | 11 | 0 | 5 | 234 | 2400.1 | 3153.1 | 3.2 | 74.4 | 8.1 | 27.9 | 11 |

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