Hog Producer's Marketing Decisions Under Alternative Utility Specifications

by

Brian Adam and Philip Garcia

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Participants in livestock markets face considerable price risk. Recently, the use of options on agricultural commodities has been proposed as an alternative to alleviate this problem. Buying a put option, for example, establishes a price floor but allows a trader to take advantage of upward price movements. However, options are not a universally attractive solution. The large number of marketing alternatives that exist with the use of options makes it difficult to identify the most attractive strategies. More importantly, the availability of options has led analysts to question the usefulness of the traditional mean-variance approach for risk management. For traditional portfolio choices, the mean-variance may approximate utility maximizing choices very well (Kroll, Levy and Markowitz, 1984). However, options can truncate and highly skew the returns distributions from alternative marketing strategies (Cox and Rubinstein, 1985). Evaluation of these strategies in a framework which only examines the mean and variance of the returns distribution may distort the identification of the optimal choices. This seems particularly likely when producers' preferences for a positively skewed distribution of returns are permitted to affect the choice of hedging strategies.

The purpose of the paper is to examine the appropriateness of the mean-variance approach for making producer decisions in the presence of options strategies. A simulation analysis is used to examine a hog producer's choices of marketing strategies. The producer maximizes expected utility based on expectations about the ending cash and futures price distributions and various degrees of risk preference. Mean-variance (MV) results are contrasted with third- (CR3) and second-order (CR2) Taylor series expansions (Cox-Rubinstein) of a constant elasticity utility function which reflects decreasing absolute risk aversion. The CR3 specification also permits positive skewness, as well as the mean and variance, of the returns distribution to influence the selection of the optimal strategy. The analysis is performed in an environment which recognizes the discrete nature of futures and options contracts, permitting only their integer multiples as possible choices.

The results provide guidelines on the sensitivity of hog producer's optimal marketing strategies to alternative utility specifications. Specifically, the findings provide insight into the usefulness of the mean-variance approach for risk management in the presence of options and preferences for positively skewed returns distributions.

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The paper is comprised of several sections which identify the model and procedures and provide a concise statement of the simulation procedure.[1] This is followed by a presentation of the findings and conclusions.

The Theoretical Model and Utility Formulations

A two-period model is used to simulate a hog producer's choice of pricing strategies for varying levels of risk. Given an expectation of the distribution of futures prices, the producer maximizes expected utility by buying or selling puts, calls and futures contracts. These contracts are offset at the time the cash commodity is sold.

Specifically, the producer maximizes the expected utility of profit by taking positions in the futures and options markets, given an initial cash position. Profit (R) is represented as the sum of the transactions made in futures, options and cash markets. Formally, R is

$$R = g(I)p_y - rI + \Sigma_j[p_j^2 - rp_j^1]P_j + \Sigma_i[c_i^2 - rc_i^1]C_i + [f^2 - f^1]F \quad (1)$$

where:

- R = profit
- I = investment in production of cash commodity
- $g(I)$ = production function for cash commodity
- r = risk-free rate of return + unity
- p_j^t = price of put option at jth strike price in period t, t = 1,2
- c_i^t = price of call option at ith strike price in period t, t = 1,2
- p_y = price of futures contract in period t, t = 1,2

F, P_j, C_i are number purchased of futures contracts, puts at the jth strike price and calls at the ith strike price (negative values of F, P_j, and C_i indicate sales rather than purchases in period 1).

In this framework, the producer's problem is to

$$\max_{I,P_j,C_i,F} EU(R) \quad (2)$$

s.t. F, P_j, C_i are integers

or,

$$\max_{I,P_j,C_i,F} \int U(R)\ F'(R)dR \quad (3)$$

s.t. F, P_j, C_i are integers

[1] Additional information concerning the model, its specification and optimization procedures are found in "Incorporating Options and Forecast Information in Producer Hog Marketing Strategies: Conceptual and Measurement Issues," Brian Adam, Ph.D. Thesis, University of Illinois, 1990.

The producer's subjective expectations enter the model through the parameters of F'(R). The nature of the producer's utility function enters the model through the specification of U(R).

Three utility specifications representing U(R) are examined in the analysis: Mean-Variance, MV; and a third-, CR3, and second-order, CR2, Cox-Rubinstein functions. Table 1 identifies the functions and provides the Arrow-Pratt measures of risk aversion for the MV and CR formulations.

The MV framework is consistent with expected utility maximization only when the agent's preferences or probability distribution are restricted (Meyer, 1987). A sufficient restriction on preferences is that the utility be quadratic. Since quadratic utility implies that the Arrow-Pratt risk aversion coefficient is increasing with wealth, the opposite of what many people believe about agent's risk preferences, it is often rejected except as a local approximation to some other utility function. Another sufficient restriction, based on the agent's choice set, is that the probability distribution of returns be normal. However, the normal distribution may not accurately reflect the true distribution of outcomes since prices may not be distributed normally (Judge et al, 1980, p.299). Also, normality may not be appropriate in the presence of options since options positions can create skewed returns distributions. Meyer (1987) identifies a less objectionable restriction on the agent's choice set that still allows consistency between a mean-standard deviation model and expected utility. The restriction is that the choice set be made up of random variables which differ from one another only by location and scale parameters. Many two-parameter families of distributions, such as the normal and uniform, satisfy this condition, but others, such as the lognormal, do not. The form of the mean-variance specification used in this analysis is: $EU(R) = m - (q/2)v$, where m is the mean of the outcome distribution and v is the variance of the outcome distribution. If the mean-variance specification of expected utility is assumed to have been derived from a negative exponential utility function, q (a constant) is the Arrow-Pratt measure of absolute risk aversion.

The use of options in marketing strategies raises questions about the appropriateness of the mean-variance framework. Options positions can result in highly skewed outcome distributions suggesting that it may be important to examine a producer's preference for skewness. The CR3 utility formulation permits an assessment of the effect of positive skewness in the returns distribution on the selection of marketing alternatives. The form of the CR3 utility function used here is

$$EU(R) = (1/(1-d))m^{1-d} - (1/2)dm^{-d-1}v + (1/6)d(d+1)m^{-d-2}s$$

where R = profit, m = mean, v = variance, s = skewness, and d = the level of constant relative risk aversion. The CR3 function is a third-order Taylor series expansion of a constant elasticity utility function. The constant relative, or decreasing absolute, risk aversion characteristic of the CR function implies that as a decision-maker's wealth increases, more is allocated to risky assets.

A CR2 formulation also is used in the analysis. It is a second-order Taylor series expansion of a constant elasticity utility function which includes only terms containing the mean and variance. Specifically, it can be expressed as

$$EU(R) = (1/(1-d))m^{1-d} - 1/2dm^{-d-1}v$$

where the terms have been previously defined. The use of this particular specification permits a comparison of the traditional mean-variance specification which is characterized by constant absolute risk aversion with a mean-variance specification reflecting decreasing absolute risk aversion.

Empirical Specification

The Producer Model

The hog producer is assumed to farrow 125 pigs in period 1, which he will sell in six months (period 2) at a weight of 240 pounds each. The six month period represents the approximate lag between farrowing pigs and selling them for slaughter. Note that since the investment decision already has been made in the simulation and because many hogs are grown in modern confinement operations, changes in production and quantity risk are not considered. Additionally, it is assumed that no trades take place between period 1 and period 2. This assumption may limit the producer's potential returns, since it understates the value of options; options premiums prior to expiration are comprised of time value in addition to intrinsic value, whereas at expiration no time value remains. On the other hand, this formulation reduces the resources allocated to making marketing decisions.

Given these assumptions, producer income[2], R, can be written as

$$R = Qp_y + \Sigma_j(\mathrm{Max}[x_j^p - f^2,0] - rp_j^1)P_j + \Sigma_i(\mathrm{Max}[f^2 - x_i^c,0] - rc_i^1)C_i \qquad (4)$$
$$+ (f^2 - f^1)F$$

where: Q is quantity of the cash commodity to be sold in period 2,
x_j^p is the jth strike price for put options,
x_i^c is the ith strike price for call options,
rp_j^1 is the discounted premium of a put option at the jth strike price in period 1, and
rc_i^1 is the discounted premium of a call option at the ith strike price in period 1.

With an initial cash position, Q, the producer maximizes income by simultaneously choosing P_j, the number of put options to buy or sell, C_i, the number of call options to buy or sell, and F, the number of futures contracts to buy or sell. The 0 values in R reflect the possibility that the purchaser of an option may not exercise it when this exercise would not be profitable.

[2]Costs (now fixed) are no longer subtracted, so R is income, not profit.

The expected utility can now be written in terms of the distribution of cash and futures prices

$$EU(R) = \int_{LF}^{UF} \int_{LC}^{UC} U(R)\ L'(P_y, f^2) dP_y df^2 \tag{5}$$

where $L'(p_y, f^2)$ is the joint distribution of cash price and futures price, LF and UF are the lower and upper bounds of integration for the futures price distribution, and LC and UC are the lower and upper bounds for integrating over the conditional cash distribution.

To compare the results from the different expected utility specifications, the risk parameters for the various utility specifications (q and d) should reflect similar levels of risk aversion. Here, for each value of q, the Arrow-Pratt measure of absolute risk aversion, and a value of R, producer income, a value of d can be calculated from the equation $d = R \bullet q$. This relationship can be derived by setting equal to each other the Arrow-Pratt measures of absolute risk aversion from each utility specification. Using values of q specified from the range suggested by Holt and Brandt for hog producers and setting R at the $/cwt market value of futures contract, values of d are calculated: Risk Averse ($q = 0.030$, $d = 1.32$), Slightly Risk Averse ($q = 0.10$, $d = 0.44$), and Risk Neutral ($q = 0.0002$, $d = 0.0088$).

Comparisons of expected utility are often difficult to interpret since the units of utility are utils. To express the comparison in money terms, certainty equivalence (CE) is used. CE is the difference between the expected value and the risk premium. Comparing a producer's certainty equivalent for two different marketing strategies under the same price distribution indicates the money value to producer of choosing the strategy with higher utility over the one with lower utility. CE also can be used to evaluate differences from choosing similar marketing strategies under alternative utility specifications. In the case of the mean-variance specification, the CE is the expected utility (Robison and Barry, p. 90). For the Cox-Rubinstein formulation, CE is calculated as $CE = [E(U) \bullet (1-d)]^{(1/(1-d))}$ (Cox and Rubinstein, pp. 320-321).

Price Structure

Given a specific utility formulation, a producer's expectations of the mean and volatility of prices play an important role in the maximizing process. Price expectations enter into the analysis based on a set of price scenarios. The scenarios are built around a base scenario where the producer takes the market's expectations of mean and volatility as his own. Other scenarios vary the parameters of the density function in order to analyze the choice of marketing strategies when the producer's expectations differ from those of the market. Parameters different from the market imply that the producer's subjective probability distribution differs from the market's expectations. A higher (lower) mean for the futures price implies that the producer believes that the current futures price underestimates (overestimates) the price in period 2. A higher (lower) annualized volatility indicates that the producer believes the market is underestimating (overestimating) the dispersion of prices around the mean in period 2.

The structure of the scenarios was formulated to reflect representative price variation and means for the 1980-88 period. For all scenarios, the current futures price for the contract expiring six months later (period 2) is \$44/cwt and is used as the market's expectation. The market's expectation of the volatility of prices in period 2 is an annualized volatility of 0.23 which is based on an average of six-month volatilities for the futures close. The cash and futures means range from \$40/cwt to \$48/cwt with more observations near the \$44/cwt market expectations. This range reflects an increase or decrease from the market of about 9%. For the bulk of the analysis, the annualized volatility is varied from 0.16 to 0.30. This range reflects a difference in annualized volatility expectations from the market's implied volatility of up to 30%.

The cash and future prices are specified to follow a bivariate lognormal distribution (Johnson, 1987). Selection of this representation is based on previous research and the results of statistical testing which could not reject lognormality of cash and futures[3]. Throughout the analysis, the expected mean of cash and futures is assumed equal with a correlation of 0.95. Period 1 option premiums are assumed to agree with calculated values from Black's model using an annualized volatility of 0.23 and a underlying price of \$44/cwt.

Transaction Costs

A cost of using futures and options contracts that has been omitted from many previous examinations of marketing alternatives is commission costs. Here, the commission costs are: 1) round-trip futures contract - \$80/contract or \$0.27/cwt; 2) options - 5% of the premium on each purchase or sale (e.g. an at-the-money option with a premium of \$2.76/cwt would cost \$0.14/cwt if the option were allowed to expire, and \$.28/cwt if it were offset with another purchase or sale in the options market.). The commission costs assumed here are those that would be charged a small producer, one who only trades one or a few contracts at a time, by a full-service broker. Since average commission costs typically decrease as the number of contracts traded increases, these costs may be higher than many producer would be required to pay. Also, because full-service quotes were used, discounts may be available. Thus, the commission costs assumed here may influence the results slightly in the direction of a cash-only marketing strategy.

Solution Procedures and Market Alternatives

While a mean-variance specification of expected utility, at times, may provide analytical solutions for the hedging model (Wolf, 1987), other specifications, in general, do not. Two methods were considered for solving the problem. The first optimizes expression (5) by iterating between a numerical integration (quadrature) routine and a nonlinear optimization

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[3]Skewness in the lognormal distribution is positively related to the volatility of the distribution. Also, because of the exponential nature of the function, higher means result in larger differences between the mean and median and a higher degree of skewness.

routine (Kaylen, Preckel and Loehmann). The numerical integration routine is used to integrate over the probability density function, and the optimization routine maximizes the function over the number of puts, calls and futures contracts to buy or sell. This approach has the advantage that, at least theoretically, it considers all possible numbers of contracts to buy or sell. Its major disadvantage is the problem of integer restrictions on the quantities of contracts purchased or sold. Allowing non-integer solutions ignores the marketing constraints and reduces the attractiveness of options positions which can be formulated to represent various non-integer market positions.

A second procedure evaluates each possible combination of puts, calls, and futures contracts without using an optimization routine. By numerically integrating expressions (6) through (8) below, the mean, variance and skewness of returns for each combination of puts, calls and futures contracts can be determined.

$$m = E(R) = \int \int R \; f(p_y, f^2) \; p_y \; f^2 \tag{6}$$

$$v = E(R-m)^2 = \int \int (R - m)^2 \; f(p_y, f^2) \; p_y \; f^2 \tag{7}$$

$$s = E(R-m)^3 = \int \int (R - m)^3 \; f(p_y, f^2) \; p_y \; f^2 \tag{8}$$

Then, using the MV, CR2 and CR3 specifications previously presented, the expected utility can be calculated. The strategies can then be ranked in terms of expected utility or certainty equivalents to determine the most attractive strategies. The advantage of this approach is that only integer multiples of contracts are evaluated. Its major disadvantage is its inability to evaluate all combinations of contracts that a producer might consider. That is, the number of solutions for even a rather straightforward situation can become extremely large.

Because it allows for integer restrictions, the second alternative with modifications to reduce the number of alternatives considered is used. Here, the producer is assumed to have an initial cash position of 30,000 lbs (the quantity represented by each live hog futures or options contracts) and is permitted to buy or sell only one put, call or futures contract each. The small initial cash position and limiting the number of contracts emphasizes the hedging component of these market activities. In addition, three strike prices for puts and three for calls are considered; one at-the-money, and one on either side of the at-the-money strike. These assumptions reduce the number of possible market strategies to 2187. Even this reduced number of possible strategies is substantially larger than the number considered by previous studies.

Empirical Results

The effects of alternative utility specifications on strategy selection and differences in certainty equivalents are examined over 56 scenarios of expected prices (means and volatilities) for three utility representations (CR3, CR2 and MV), and for three levels of risk aversion for each utility representation (risk averse, slightly risk averse and risk neutral). This amounts to examination of 504 combinations of utility specifications and expected price distributions. Table 2 provides the summary results of these simulations.

The rows of table 2, which reflect the alternative scenarios of ending price distributions, are arranged in groups by increasing annualized volatility (Vol) of the price distribution in period 2, from 9 to 30. At each level of volatility, the expected means of the distribution also are arranged in ascending order from 40 to 48 $/cwt. The columns indicate the best strategies associated with each expected price distribution for each utility representation and level of risk aversion. For three levels of risk aversion, the CE for the CR3 utility specifications is presented as well as the differences in CE between choosing the best strategy using MV and CR2 specifications and choosing the identical strategy using the CR3 specification. For example, for the Risk-Averse producer with expectations for the volatility (Vol) and mean equal to 23 and $48/cwt, respectively, (scenario 57) different strategies are chosen under each utility function (i.e., CR3 - strategy 1836; MV - strategy 743; and CR2 - strategy 1472). Under the CR3 specification, the CE for strategy 1836 equals $51.56/cwt. Use of the optimal MV and CR2 strategies under the CR3 specification results in a CE reduction of $3.58/cwt and $3.20/cwt, respectively. At the market expectations (scenario 54, Vol = 23 and mean = $44/cwt), for the Risk-Averse producer, all three specifications (CR3, MV and CR2) indicate that strategy 365 is the best. Here, clearly, there is no difference in the certainty equivalents.

Several points emerge from table 2. First, as might be expected, there are no differences in the strategy selection for the Risk-Neutral case for the three utility representations considered. When higher moments of the formulations are given zero weight, the producer makes his decision based solely on maximizing the expected return which results in the selection of identical strategies under similar price scenarios. Second, as the degree of risk aversion increases, differences between optimal strategies are more apparent. Under the Risk-Averse specification, roughly 46% of the scenarios resulted in differences in strategy selection and differences in CE between the CR3, and the MV and CR2 representations. Under the Slightly-Risk-Averse specification, about 24% of the scenarios resulted in differences in strategy selection and CE between the CR3, and the MV and CR2 formulations. As higher moments of the formulations receive increasing weights their importance in the decision process also increases, resulting in differences in the strategy selected and certainty equivalents.

Third, the most dramatic differences in CE occur when the producer's expectations of the mean and volatility are higher than the market. Consider the differences between CR3 and MV for the Risk-Averse producer. When either the expected mean, expected volatility, or both, are lower than the market's expectation, the loss in CE is rather small. For example, when the expected volatility is 23 or less and the expected mean is 46 or less, the loss in CE is always less than $0.50/cwt, and often is zero. Larger differences in CE materialize when either the expectations of the volatility or mean exceed those of the market's. When the producer's expectation for the volatility is the same as the market's, but the mean expectation is $48/cwt, the difference in CE when using the best MV strategy is $3.58/cwt. In the case where the producer's expectation for the mean is the same as the market's, but is 30 for the volatility, the difference in CE when using the MV strategy is \$3.82/cwt. When expectations for both the volatility and the mean are higher than the market's expectations, the differences in CE become large even for small deviations from market expectations. For example, when the expected volatility is 24.75 and the expected mean is 46, the difference in CE between the MV and the CR3 is \$1.26/cwt. This difference increases as deviations between the producer's and market's expectations of the mean and volatility increase; when the expected volatility is 30 and the expected mean is \$48/cwt, the difference in CE between the MV and CR3 strategies is \$9.41/cwt. A similar pattern in CE loss occurs in the Slightly-Risk-Averse case, but its extent is less dramatic.

Fourth, in general, a similar pattern in CE loss occurs when comparing the CR3 to the CR2 formulation. This last point suggests that differences in the results between the CR3, and the MV and CR2 functions are not that highly influenced by the type of absolute risk aversion specified. Recall that the CR3 and CR2 functions are characterized by decreasing absolute risk aversion while the MV can be characterized by either a constant or increasing absolute risk aversion depending upon its derivation and justification. Direct comparison of the CR2 and MV functions (by examining the difference in loss when using MV instead of CR3 and the loss when using the CR2 instead of the CR3 function) suggests that while noticeable differences in CE occur, they are relatively small. For the Slightly-Risk-Averse case, many of the differences in CE are zero and only 7 of the 56 price scenarios result in differences of \$0.50/cwt or more. For the Risk-Averse case, again many of the differences in CE are zero and only 5 of the 56 price scenarios result in differences of \$0.50/cwt or more. In general, the large differences in CE between the MV and the CR2 occur when the producer's mean expectations differ substantially from the market's mean expectations.

Finally, it appears that the important differences between the CR3, and the MV and CR2 primarily result from the capability of the CR3 function to account for producer's preference for positive skewness and the increased skewness of the returns distribution. The skewness of the returns distribution is likely influenced by the presence of options and the effect of increased means and volatilities on the skewness of prices associated with the lognormal distribution.

Summary and Conclusions

The use of options has been proposed as an alternative to alleviate the problems associated with price risk in livestock markets. The availability of options has led to some concern over the usefulness of the traditional mean-variance framework for risk management. The use of options can truncate and highly skew the returns distributions from marketing strategies. Evaluation of strategies solely within the mean-variance framework, which does not account for the skewness, may distort the identification of optimal alternatives and could result in differences in returns to the producer. This may be particularly true when preferences for a positively skewed returns distribution are permitted to affect the choice of hedging strategies.

Here, using a two-period simulation model of hog producer's hedging decisions, we investigate differences in optimal strategies and ex ante utility to producers (measured in terms of certainty equivalents) under alternative utility representations in the presence of options and futures contracts. In the decision model, the producer maximizes ex ante utility based on expectations about the ending cash and futures price distributions under various utility specifications. Differences in the producer's mean and volatility expectations from the market's expectations drive the producer's marketing decisions. Mean-variance results are contrasted with third- and second-order Taylor series expansions of the Cox-Rubinstein constant elasticity utility function which both reflect decreasing absolute risk aversion. The third-order Cox-Rubinstein formulation also permits the positive skewness of the returns distribution often imparted by options positions to influence the selection of the optimal strategy. Three different levels of risk preferences are examined for each of the functions: Risk Averse, Slightly Risk Averse, and Risk Neutral. The analysis is performed in an environment which recognizes the discrete nature of futures and options contracts by permitting only integers as possible choices.

Within the decision framework considered here, the findings of the research suggest that the mean-variance framework provides a good approximation to more general utility formulations except for the Risk-Averse producers when expected mean and volatility are considerably different, especially higher, than the market's expectations. For the Risk-Neutral and Slightly-Risk-Averse producer a high degree of correspondence existed between optimal strategies selected under the various utility representations. In the Risk-Neutral case, no deviations in strategies occurred; in the Slightly-Risk-Averse case, approximately 75% of the scenarios resulted in identical strategy selection. Here, deviations appeared at expectations higher than the market's expectations. For the Risk-Averse case, only approximately 50% of the scenarios resulted in identical strategy selection between the MV and the CR3 functions. Again, the differences in strategies and the larger loss in CE materialize as the producer's expectations differ from the market's expectations, particularly when they are higher than the market's. Here, the magnitude of the CE loss appears to be rather large for modest changes in the mean and volatility expectations. An expected volatility of 24.75 (i.e., a 7.6% increase above the market's expectation of 23) and an expected mean of 46 (i.e., a 4.5% increase above the market's expectation of 44) results in a $1.26/cwt difference in CE.

The source of the difference is primarily related to the skewness of the returns distribution and the capability of the more general function to account for producer preferences for positive skewness under increasing risk aversion. Only modest differences in the strategy selection and changes in CE were associated with the type of absolute risk aversion preferences reflected in the functions. Instead, at higher levels of risk aversion, more weight is placed on the higher moments of the CR3 utility function resulting in different strategy selection. The importance of producer preferences for positive skewness is most dramatically manifested when the producer's expectations of price means and volatility increase relative to the market. Higher mean and volatility expectations influence the positive skewness of the returns distribution which the producer can obtain through appropriate use of cash, futures and options markets.

Table 1

Arrow-Pratt Risk Measures

Utility Specification	$AP = -U''/U'$	$AP' = dAP/dR$
Mean-Variance:		
(1) negative exponential		
$U(R) = -e^{-qR}$	$q > 0$	0
(2) quadratic		
$U(R) = a + bR + cR^2$	$-2c/(b + 2cR) > 0$	$4c^2/(b + 2cR)^2 > 0$
	$c > 0$	$c > 0$
Cox-Rubinstein:		
$U(R) = (1/(1-d))R^{1-d}$	$d/R > 0$	$-d/R^2 < 0$
	$d > 0$	$d > 0$

Table 2

Best Strategies under CR3 vs. Best Strategies under MV and CR2

			Risk Averse						Slightly Risk Averse						Risk Neutral					
			CR3		MV		CR2		CR3		MV		CR2		CR3		MV		CR2	
Scen	Vol	Mean	Best	CE	Best	Loss	Best	Loss	Best	CE	Best	Loss	Best	Loss	Best	CE	Best	Loss	Best	Loss
11	9	40	460	53.55	460	0.00	460	0.00	703	53.97	703	0.00	703	0.00	703	54.23	703	0.00	703	0.00
12	9	42	28	51.31	28	0.00	28	0.00	28	51.43	28	0.00	28	0.00	28	51.49	28	0.00	28	0.00
13	9	43	1	51.79	1	0.00	1	0.00	1	51.99	1	0.00	1	0.00	1	52.08	1	0.00	1	0.00
14	9	44	730	52.28	730	0.00	730	0.00	730	52.53	730	0.00	730	0.00	730	52.64	730	0.00	730	0.00
15	9	45	1459	53.50	1459	0.00	1459	0.00	1459	53.78	1459	0.00	1459	0.00	1459	53.91	1459	0.00	1459	0.00
16	9	46	1468	54.88	1468	0.00	1468	0.00	1468	55.18	1468	0.00	1468	0.00	1468	55.31	1468	0.00	1468	0.00
17	9	48	1484	60.22	1483	0.08	1484	0.00	1484	61.43	1484	0.00	1484	0.00	1485	62.21	1485	0.00	1485	0.00
21	16	40	703	51.37	460	0.09	703	0.00	703	53.20	703	0.00	703	0.00	703	54.08	703	0.00	703	0.00
22	16	42	109	47.28	109	0.00	352	0.05	352	48.03	352	0.00	352	0.00	379	48.49	379	0.00	379	0.00
23	16	43	28	46.31	28	0.00	28	0.00	28	47.13	28	0.00	28	0.00	28	47.49	28	0.00	28	0.00
24	16	44	757	46.20	757	0.00	730	0.09	730	47.17	730	0.00	730	0.00	730	47.66	730	0.00	730	0.00
25	16	45	739	47.09	739	0.00	1459	0.17	1468	48.37	1468	0.00	1468	0.00	1468	49.27	1468	0.00	1468	0.00
26	16	46	1468	49.01	1468	0.00	1468	0.00	1471	50.88	1471	0.00	1471	0.00	1484	52.32	1484	0.00	1484	0.00
27	16	48	1484	55.36	1472	0.42	1481	0.05	1485	59.53	1485	0.00	1485	0.00	1485	62.00	1485	0.00	1485	0.00
31	19.5	40	703	49.78	460	0.20	703	0.00	703	52.60	703	0.00	703	0.00	703	53.98	703	0.00	703	0.00
32	19.5	42	361	45.05	352	0.03	352	0.03	379	46.57	379	0.00	379	0.00	703	48.07	703	0.00	703	0.00
33	19.5	43	1081	44.12	1081	0.00	1081	0.00	352	44.94	352	0.00	352	0.00	352	45.80	352	0.00	352	0.00
34	19.5	44	1090	44.13	847	0.03	847	0.03	847	44.52	847	0.00	847	0.00	730	45.02	730	0.00	730	0.00
35	19.5	45	850	44.80	850	0.00	850	0.00	742	45.76	742	0.00	742	0.00	1472	47.59	1472	0.00	1472	0.00
36	19.5	46	770	46.13	742	0.22	742	0.22	1472	48.79	1472	0.00	1472	0.00	1485	51.98	1485	0.00	1485	0.00
37	19.5	48	1485	52.69	1471	1.45	1472	0.71	1485	58.31	1484	0.77	1485	0.00	1485	61.87	1485	0.00	1485	0.00
41	21.25	40	703	48.86	460	0.26	703	0.00	703	52.26	703	0.00	703	0.00	703	53.93	703	0.00	703	0.00
42	21.25	42	361	44.41	361	0.00	361	0.00	676	45.94	676	0.00	460	0.04	703	48.01	703	0.00	703	0.00
43	21.25	43	364	43.83	364	0.00	364	0.00	361	44.25	361	0.00	352	0.18	352	45.17	352	0.00	352	0.00
44	21.25	44	1093	43.76	1093	0.00	1093	0.00	1093	43.96	1093	0.00	1093	0.00	850	44.10	850	0.00	850	0.00
45	21.25	45	1094	44.36	850	0.11	850	0.11	770	45.04	770	0.00	770	0.00	1484	46.96	1484	0.00	1481	0.00
46	21.25	46	851	45.53	851	0.00	770	0.19	1472	47.73	1472	0.00	1472	0.00	1485	51.91	1485	0.00	1485	0.00
47	21.25	48	1512	51.68	1471	2.15	1472	1.32	1485	57.67	1484	0.94	1485	0.00	1485	61.80	1485	0.00	1485	0.00
51	23	40	712	47.87	676	0.42	703	0.19	703	51.81	703	0.00	703	0.00	703	53.86	703	0.00	703	0.00
52	23	42	607	44.17	607	0.00	607	0.00	712	45.50	676	0.22	703	0.21	703	47.93	703	0.00	703	0.00
53	23	43	365	43.65	365	0.00	365	0.00	607	43.86	607	0.00	607	0.00	703	44.93	703	0.00	703	0.00
54	23	44	365	43.64	365	0.00	365	0.00	1094	43.74	1094	0.00	1094	0.00	1094	43.99	1094	0.00	1094	0.00
55	23	45	1094	44.23	1094	0.00	1094	0.00	1094	44.73	1094	0.00	1094	0.00	1485	46.85	1485	0.00	1485	0.00
56	23	46	1863	45.34	1094	0.12	1094	0.12	1836	47.45	1499	0.71	1499	0.71	1485	51.82	1485	0.00	1485	0.00
57	23	48	1836	51.56	743	3.58	1472	3.20	1485	56.91	1484	1.14	1485	0.00	1485	61.72	1485	0.00	1485	0.00
61	24.75	40	713	47.52	679	0.54	703	0.88	703	51.43	703	0.00	703	0.00	703	53.81	703	0.00	703	0.00
62	24.75	42	689	44.32	446	0.15	689	0.00	715	45.58	715	0.00	713	0.00	703	47.86	703	0.00	703	0.00
63	24.75	43	608	43.76	608	0.00	608	0.00	689	44.12	689	0.00	689	0.00	704	44.85	703	0.01	703	0.01
64	24.75	44	365	43.63	365	0.00	365	0.00	1337	43.82	1337	0.00	1337	0.00	1094	43.99	1094	0.00	1094	0.00
65	24.75	45	1944	44.25	1337	0.09	1337	0.09	1095	44.80	1094	0.10	1094	0.10	1836	46.93	1836	0.00	1836	0.00
66	24.75	46	2160	46.38	1094	1.26	1094	1.26	1836	47.79	1824	0.79	1824	0.79	1485	51.75	1485	0.00	1485	0.00
67	24.75	48	1836	51.95	1823	3.37	1580	3.56	1485	56.30	1484	1.32	1485	0.00	1485	61.65	1485	0.00	1485	0.00
71	26.5	40	715	47.47	680	0.64	707	0.10	703	50.96	703	0.00	703	0.00	703	53.75	703	0.00	703	0.00
72	26.5	42	689	44.58	689	0.00	689	0.00	716	45.97	716	0.00	716	0.00	703	47.80	703	0.00	703	0.00
73	26.5	43	608	43.89	608	0.00	608	0.00	716	44.52	689	0.07	689	0.07	716	45.36	716	0.00	716	0.00
74	26.5	44	2187	44.03	1418	0.17	1418	0.17	1418	44.13	1418	0.00	1418	0.00	1422	44.54	1422	0.00	1422	0.00
75	26.5	45	2187	45.80	1337	1.51	1337	1.51	2160	45.21	1338	0.25	1338	0.25	1836	47.51	1836	0.00	1836	0.00
76	26.5	46	1944	47.78	1094	2.78	1094	2.78	2079	48.19	1098	1.17	1098	1.17	1485	51.67	1485	0.00	1485	0.00
77	26.5	48	2079	52.69	1095	4.65	1823	4.47	1728	55.78	1754	1.66	1485	0.14	1485	61.58	1485	0.00	1485	0.00
81	30	40	716	48.08	716	0.00	716	0.00	707	50.58	707	0.00	704	0.23	703	53.60	703	0.00	703	0.00
82	30	42	717	45.61	1445	0.29	1445	0.29	717	47.13	717	0.00	717	0.00	716	48.18	716	0.00	716	0.00
83	30	43	2187	46.73	1445	1.81	1445	1.81	720	46.18	720	0.00	720	0.00	720	47.00	720	0.00	720	0.00
84	30	44	2187	48.47	1418	3.82	1418	3.82	1458	46.11	1446	0.37	1446	0.37	1458	47.23	1458	0.00	1458	0.00
85	30	45	2187	50.25	1418	5.38	1418	5.38	2187	47.76	1449	1.10	1449	1.10	2160	49.33	2160	0.00	2160	0.00
86	30	46	2187	52.07	1337	6.85	1419	6.10	2160	50.10	1422	2.17	1431	1.04	1836	52.59	1836	0.00	1836	0.00
87	30	48	2160	56.07	1094	9.41	1338	7.94	1836	56.38	1107	2.38	1836	0.00	1485	61.40	1485	0.00	1485	0.00

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