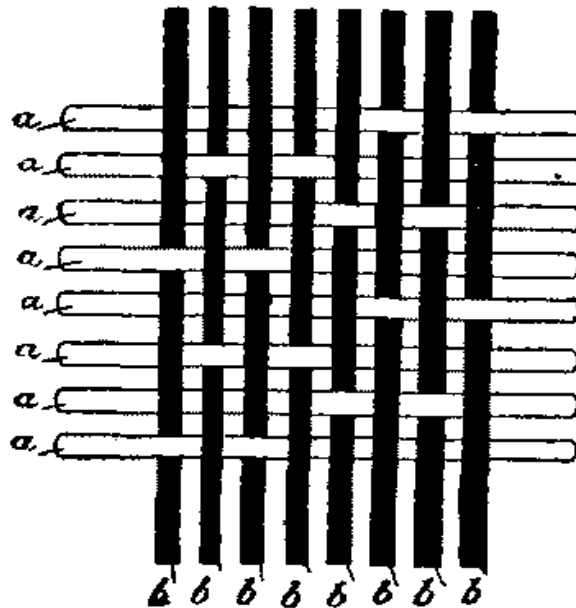


Thomas Simpson, The Weaver Mathematician (1710-1761)

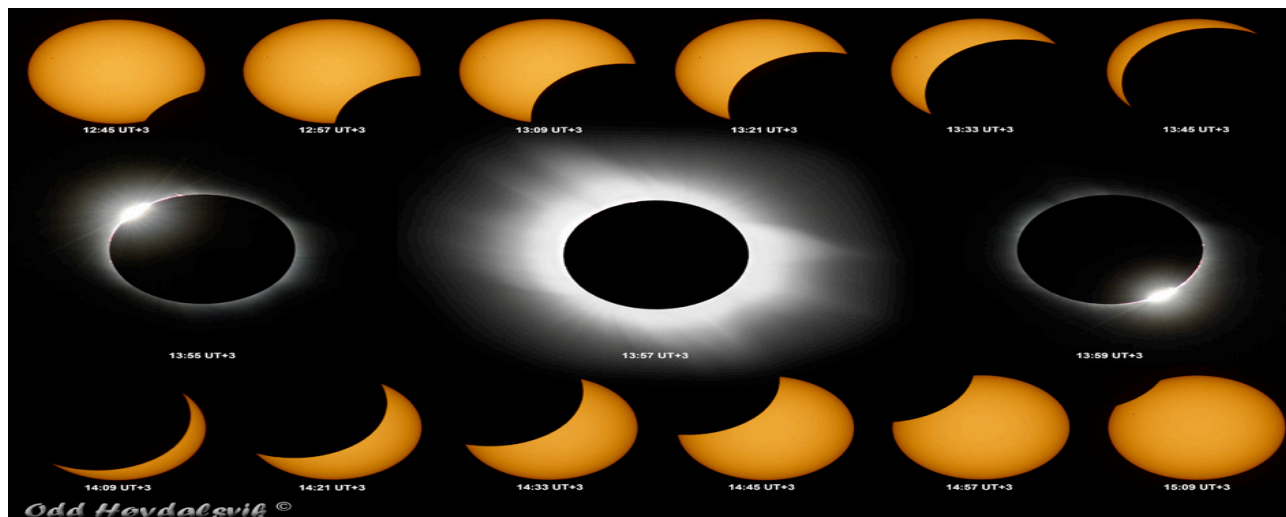
by: Kimberly Kolafa





- Born in Leicestershire on August 20, 1710
- A Weaver, His Father's trade
- Weaving- action of creating cloth by interweaving two layers of thread usually at ninety degree angles.
- Open Simpson's eyes to bisection of 90 degree angles
- Common for Weaver's to become mathematicians due to connection the thread and angles needed interweaving layers.
- allowed Simpson to solve problems without formal education.



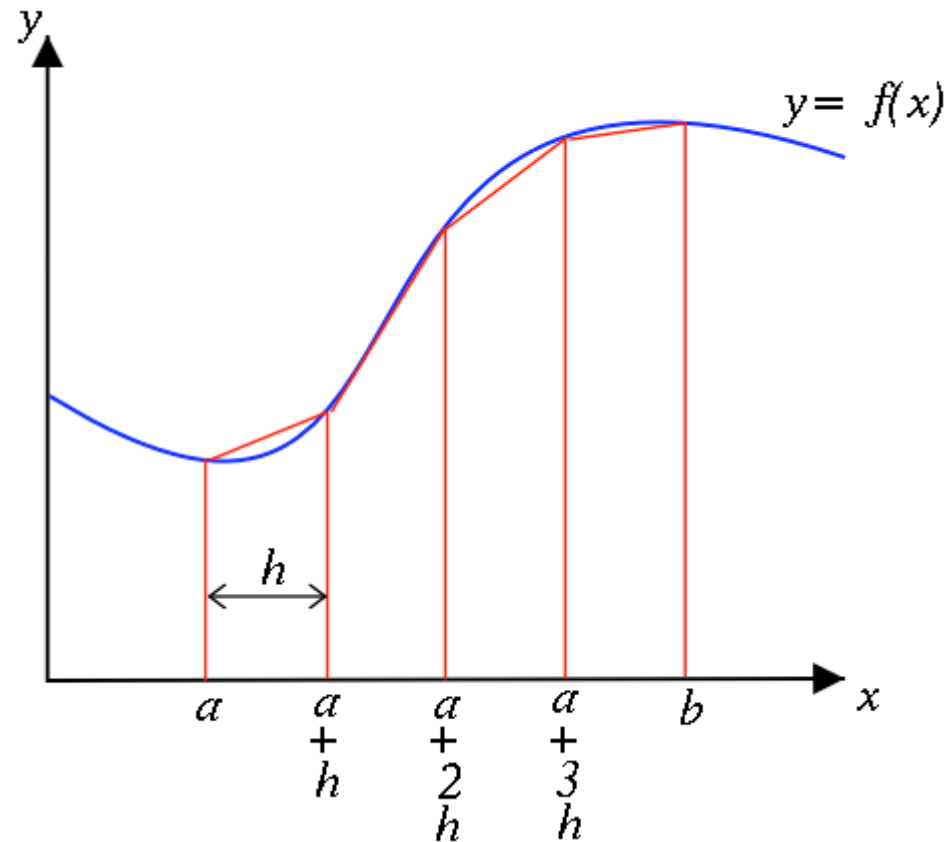
- Moved away at the age of 14, settled in a lodging house with Mrs. Swinfield.
- Solar Eclipse in 1724 sparks mathematical and astronomical interests, although still a weaver.
- Noticed ways sun has been covered by each line of darkness
- Wanted to find area of the shaded region
- Could Eclipse be broken into halves, fourths, or thirds? At what time interval? nth interval?



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- “It had become customary among astronomers to use the mean of several observations to estimate the true value (covered by the sun in a solar eclipse) but an adequate theoretical background for this procedure was missing, until Simpson.”
 - Used skills acquired in weaving to seek after the understanding by the solar eclipse.
 - Simpson borrowed books from a neighbor on astronomy and mathematics
 - Mastered subjects, Now considered a “fortune-teller”

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- People believed that during the darkness of the eclipse, the devil had cursed Simpson to foretell the future.
 - Forced to leave the town after an “unfortunate accident” in fortune-telling.
 - Had to leave his family and moved to Derby-
 - member of Spitalfield’s Mathematical Society(1 of 49 members)
 - Moved to Royal Military Academy in Woolwich in 1743- Head of Mathematics


- Simpson's Rule- method for approximating definite integrals
- Similar to Trapezoidal Rule except integrand is approximated to be a quadratic rather than a straight line within each subinterval.



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- To Approximate $\int_a^b f(x) dx$, use

$$\int_a^b f(x) dx \approx \frac{h}{3} \left[f(x_0) + 4f(x_1) + 2f(x_2) + 4f(x_3) + 2f(x_4) + \cdots + 4f(x_{n-1}) + f(x_n) \right].$$


- (handout given on derivation)
- If a function is highly oscillatory, or it lacks derivatives at certain points then they usually have very poor results with Simpson's rule.
- Therefore we break up the interval $[a, b]$ into a number of small subintervals. Simpson's rule is then applied to each subinterval; the results then produce an approximation for the integral over the entire interval.

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- A town wants to drain and fill a small polluted swamp. The swamp averages 5 ft. deep. About how many cubic yards of dirt will it take to fill the area after the swamp is drained?
 - Volume of the swamp- estimate the surface area and multiply by 5. To est. area, we use Simpson's Rule with $x = 20$ and the y 's equal to the distances measure across the swamp.
 - $S = \frac{x}{3}(y_0 + 4y_1 + 2y_2 + 4y_3 + 2y_4 + 4y_5 + y_6)$
 - $S = \frac{20}{3}(145 + 488 + 152 + 216 + 80 + 120 + 13) = 8100$
 - The volume is about $(81000)(5) = 40,500 \text{ ft}^3$



Error Estimate for Simpson's Rule


- (Handout)
- Without proof, we state, Let $M = \max |f''''(x)|$ (magnitude of the 4th derivative and let ES be the error in using Simpson's estimate then
- When the magnitude of the 2nd derivative of 'f', we cannot find the exact value of the max $|f''''(x)|$ and have to replace it with an upper bound.
- $|ES| \leq M (b - a)^5/180n^4$

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- Find an upper bound for the error in estimating integral from 0 to 2 $5x^4dx$, using Simpson's Rule with $n = 4$.
 - Estimate Error- find an upper bound M for the magnitude of the 4th derivative of $f(x) = 5x^4$ on interval $0 \leq x \leq 2$.
 - Since 4th derivative has a constant value = 120., we take $M=120$.
 - With $b - a = 2$, and $n = 4$. therefore using the formula...
 - $|ES| \leq M (b - a)^5/180n^4$
 - $120(2^5)/ 180(4^4)= 1/12$.



Probability Theory


- This part of mathematics is concerned with the analysis of random phenomena that much of Simpson's life was dedicated to.
- He dealt with the probability theory of errors in measurement, dealing with dice, and finding the distribution of mean error.
- Although an individual coin toss or the roll of a die is random event, if repeated many times the sequence of random events will exhibit certain statistical patterns, which can be studied and predicted.


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- He was one of the first to realize that the chance event is uninfluenced by the events which have gone before. “If a true die has not shown six for thirty throws, the probability of a six is still one sixth on the thirty-first throw.”
 - Mortality Rates and Life Insurance
 - Much of Simpson work was a revision of De Moivre’s work




De Moivre

- Thomas Simpson wrote the book, “The Nature and Laws of Chance. The Whole After a new, general, and conspicuous Manner, And illustrated with A great Variety of Examples” in 1740.
- Unfortunately there was nothing 'new, general, or conspicuous' about it, it was simply a plagiarism of the mathematical parts of the “The Doctrine of Chances, First Edition” which was introduced by De Moivre.

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- De Moivre States: “After the pains I have taken to perfect this Second Edition, it may happen, that a certain Person, whom I need not name, out of Compassion to the Public, will publish a Second Edition of his Book on the same subject, which he will afford at a very moderate Price, not regarding whether he mutilates my Propositions, obscures what is clear, makes a Shew of new Rules, and works by mine; in short confounds in his usual way, every thing with a crowd of useless Symbols; if this be the Case, I must forgive the indigent Author and his disappointed Bookseller.”

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- Simpson fights back with an “Appendix, containing Some Remarks on Mr. Demoivre's Book on the same Subject, with Answers to Some Personal and Malignant Misrepresentations, in the Preface thereof ``...” to clear myself from a charge so highly injurious, and do justice to the foregoing work.”
 - “Lastly, I appeal to all mankind, whether in his treatment of me, he has not discovered an air of self-sufficiency, ill-nature, and inveteracy, unbecoming a gentleman.”

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- De Moivre did not respond to Simpson's remarks, but then later removed the criticisms of Simpson from the preface in following editions.
 - De Moivre's however was not the only work that there was controversy over plagiarism. The First Master at the Military Academy's books on geometry and the previous editor of the Ladies Diary, all had pressing issues with the statements that Simpson had in later books.



- Although questioned upon originality, Simpson is well noted for work in the following:
 - Theory of fluxions
 - Laws of chance
 - Algebra
 - Geometry
 - Trigonometry
 - Physical astronomy
 - Derivatives and Integration
 - Speculative Mathematics