WORKSHOP REPORT

History for Diversity in the Teaching and Learning of Mathematics

Jason H.M. Yip, Department of Design Engineering and Mathematics, Middlesex University, London, UK. Email: H.Yip@mdx.ac.uk
Ilaria Bussoli, Department of Mathematical Sciences, University of Bath, Bath, UK. Email: ib641@bath.ac.uk
Ciarán Mac an Bhaird, Department of Mathematics and Statistics, Maynooth University, Maynooth, Ireland. Email: ciaran.macanbhaird@mu.ie
Peter Rowlett, School of Computing and Digital Technologies, Sheffield Hallam University, Sheffield, UK. Email: p.rowlett@shu.ac.uk

Abstract

This paper reports on a workshop delivered at the CETL-MSOR Conference 2025 that explored the use of historical narratives to foster inclusivity, enhance student engagement, and support a stronger sense of belonging in university mathematics, particularly for under-represented groups. The workshop addressed several interconnected themes, including historically overlooked mathematicians, mathematics and statistics with problematic historical legacies, the role of historical perspectives in shaping student confidence and mathematical identity, and the use of historical mathematical methods to illuminate modern problems. Through a combination of discussion-based activities and illustrative case studies, participants considered how history can be incorporated into teaching in ways that encourage critical reflection on both the development and use of mathematical knowledge. The workshop also introduced the History for Inclusion & Diversity in Mathematics Network, which supports practitioners interested in using the history of mathematics to promote equality, diversity, and inclusion in higher education, and participants were invited to engage with the network and its resources.

Keywords: History of mathematics, inclusivity, diversity, mathematics education, higher education.

1. Introduction

There is a long-standing tradition of regarding mathematics as an abstract world which does not interact with wider society, that societal issues are not part of the discipline and not the business of those teaching it. Many draw inspiration on this theme from Hardy, who wrote in 1920: “The study of mathematics is, if an unprofitable, a perfectly harmless and innocent occupation” (Hardy, 1920).

This is quite complicated, because Hardy did not consider applied mathematics as a legitimate branch of mathematics, contrasting this with “the real mathematics of the real mathematicians” (Hardy, 1969) and thus significantly reducing the field to which his comment applied. We must also consider the time in which he was writing. In his famous *A Mathematician’s Apology* (1940) he wrote “No one has yet discovered any warlike purpose to be served by the theory of numbers or relativity, and it seems very unlikely that anyone will do so for many years. … So a real mathematician has his conscience clear” (Hardy, 1969, p. 140). He wrote about the uselessness of number theory, relativity, and quantum mechanics, writing about these before later applications were developed in cryptography, GPS, lasers, microelectronics, MRI scanners, and more.

Still, this historical baggage means it is worth saying very clearly that we believe mathematics and statistics are not neutral nor detached from society. Apart from the many uses of mathematics, there are issues to consider when mathematics interacts with society.

- Where did mathematics come from? How did we get where we are today?
- What areas of mathematics and statistics emerge from problematic origins?
- What legacy is left in modern mathematics and statistics?
- Creation of mathematical knowledge – who gets to participate, how are they funded?
- How outcomes from mathematical work are used – in policy-making, in other disciplines, etc.
- Ethics – who is impacted by the products of mathematical work, what biases are embedded?
- How mathematics and statistics are communicated to those in wider society.

For example, on the question of who gets to be a mathematician, Francis Su's excellent *Mathematics for Human Flourishing* (2020) considers the case of Sofia Kovalevskaya (1850-91). She attended university classes unofficially in Russia, before moving to Berlin to work with Karl Weierstrass. His university refused to let her attend his class despite him petitioning for this, so he tutored her privately. When she had done enough work to earn a doctorate, they worked to find a university that would give her a degree. The University of Göttingen awarded her a PhD in 1874, the first in the world to be awarded to a woman for mathematics.

Still, she could not get a job, either in Germany or Russia. She left mathematics and wrote fiction and theatre reviews instead. Su writes "we might not have benefited from her subsequent outstanding contributions in mathematics if she hadn't returned to it six years later, and tried again" (p. 141).

This raises natural questions, about how many others did not have the opportunity to have their mathematical ability recognised and nurtured, and how many did not push this hard in the face of adversity. This historical example speaks to problems that cause barriers today. One justification given for systems and structures is 'this is how it has always been'. Well, women didn't get PhDs in mathematics – until they did. Su writes beautifully (p. 143):

> *In a broken world, we must also recognise that power is often unearned, and it doesn't just come to those who would use it well. So, you and I have a responsibility, as we grow in power, to use it for good.*

Nevertheless, this example teaches us something else about diversity. Notice Su's comment about Kovalevskaya, this time with emphasis added: "**we** might not have **benefited** from her subsequent outstanding contributions in mathematics if she hadn't returned to it six years later, and tried again". This is reminiscent of the way some companies justify inclusive policies on the grounds that it benefits the bottom line. For example, Georgeac and Rattan (2022) cite this from AstraZeneca "innovation requires breakthrough ideas that only come from a diverse workforce". Must we think of 'we', the majority, and how 'we' benefit? Might we not think about Kovalevskaya, and how she benefitted from and enjoyed her work in mathematics? Georgeac and Rattan contrast AstraZeneca with this from Tenet Healthcare: "we embrace diversity because it is our culture, and it is the right thing to do".

If we wish to embrace diversity, because it is the right thing to do, we must guard against bias. Biases are natural short cuts to decision making, positive and negative. Perhaps a bias to always visit the same cafe simplifies lunch breaks on busy days, a good outcome. But we must be aware of negative biases, especially unconscious ones. Su says "It's not enough to say, 'I don't think about that stuff— I treat everyone the same,' … Those in marginalised groups don't have the luxury of saying, 'I don't think about that stuff,' because that stuff affects us on a daily basis" (p. 152).

We seek to explore opportunities to develop more inclusive curricula, fostering inclusivity and a greater sense of belonging, because it is the right thing to do, and because included students are more engaged.

Understanding where mathematics came from and the sometimes-problematic stories behind this development can help us to acknowledge or avoid presenting this in a way that excludes people. For example, Bradshaw and Mann (2021) give the example of Karl Pearson, asking "how does a student who is aware of Pearson's racism feel about using 'Pearson's correlation coefficient'?"

Also, understanding where methods came from and learning about the people who struggled to bring them into the world can help students appreciate and contextualise their own struggles.

Our workshop at the CETL-MSOR conference addressed these themes in particular, aiming to explore how using historical narratives can support inclusivity, belonging, and engagement in teaching university mathematics.

2. Mathematics and statistics with problematic stories

Although it is important and highly relevant to discuss underrepresented mathematicians and statisticians as role models for our students, it is equally crucial to address the ethical dimensions of mathematics and statistics. In the case of pure mathematics – though applied mathematics and statistics are not exempt – there is a common belief that mathematics is neutral, value-free, and therefore devoid of social responsibilities. However, recent works have started challenging this view (Chiodo and Muller, 2024; Ernest, 2021). Indeed, mathematics and statistics are deeply embedded within society: they are influenced by cultural factors, and the economic and historical context directly shapes the types of mathematical research funded by governments and institutions. Consequently, the perception of mathematics as detached from ethical and social considerations should be questioned and also challenged in the classroom, with the underlying aim to develop and nurture a critical and ethical approach in the students to mathematics and statistics.

2.1.Some examples

We discussed three examples where mathematics was not exempt from ethical consequences:

- John von Neumann (1903-1957) was an important applied mathematician whose work influenced quantum theory, game theory, and modern computer science. In 1943, he joined the Manhattan Project, a research and development program undertaken during World War II by the USA, UK and Canada to produce the first nuclear weapons. He actively worked on the calculations needed to build the atomic bomb, as well as overseeing the computations related to the expected size of the bomb blasts in Hiroshima and Nagasaki. He estimated death tolls and the distance above the ground at which the bombs should be detonated for maximum effect (that is, maximum deaths) (American History Foundation, n.d.).
- Francis Galton (1822-1911) was a polymath, anthropologist and statistician who pioneered the use of questionnaires and surveys to collect social data, as well as developing the concepts of correlation and "regression towards the mean". He is also known as the father of eugenics, a set of beliefs and practices that aim to "improve" the genetic quality of a human population by discouraging reproduction by people presumed to have inheritable undesirable traits (usually by mass forced sterilisation of non-white non-Western people, and in particular of African descendance) and encouraging reproduction by people presumed to have inheritable desirable traits (in particular, the British). In his work "*Hereditary Genius: An Inquiry into its Laws and Consequences*" (1869), he links race to intelligence and genetics: that is, he argues that intelligence is hereditary and different races, by nature, have higher/lower intelligence status. These ideas were developed further in the 19th century, culminating in the "racial improvement/breeding" carried out by the Nazist regime in Germany between 1933 and 1945 (where racial improvement implied the extermination of people with disabilities, or those who were Jewish, or Roma, or non-heterosexual) (Theories of Race, n.d.).

- The Sally Clark case is one of the most famous legal cases of miscarriage of justice in the UK, where witnesses and jury wrongly applying conditional probabilities and Bayes' theorem convicted the innocent Sally Clark. In December 1996, Sally Clark's first son died within a few weeks of his birth of unexplained causes (first piece evidence), and her second son died in similar circumstances in January 1998 (second piece of evidence). A month later, Clark was arrested and tried for both deaths. Her defence said that both children died of sudden infant death syndrome (SIDS). A paediatrician, as expert witness, testified that the chance of one child from an affluent family suffering SIDS was 1 in 8,500, concluding that the chance of two children from an affluent family suffering SIDS was 1 in 73 million (calculated as 1/8,500 × 1/8,500) – this was later disputed, as medical literature showed that susceptibility to SIDS is inherited, and therefore the probability of a second child dying for SIDS is higher and depends on the likelihood of the first child to die of SIDS. Moreover, the jury mistook the probability of both Sally Clark's children dying of SIDS conditional to her being not guilty (1 in 73 million) with the probability of her being not guilty given that both her children died of SIDS, wrongly concluding that she was guilty beyond reasonable doubt (Wikipedia contributors, n.d.).

2.2. How to incorporate ethical aspects of mathematics in the classroom

We discussed possible challenges when adapting such historical sources in a classroom, identifying four major ones that change the type of resource one can produce.

1. The **class size** shapes the level of engagement and discussion that we can have with students; we discussed that, with classes up to 50 students, it is possible to discuss in groups and monitor and guide some of the points of discussion. With classes with over 50 students, these resources can be used to introduce a theoretical concept (e.g., Bayes' theorem), or can be a point of reflection later developed in tutorials (which comprise around 30 students).
2. The **type of classes** shapes the interaction we have with students too: in a lecture scenario, resources can be shared as examples between theorems or definitions, or provided in lecture notes for further reading. In problem classes, these resources seem working better when redirected to students in the form of questions to discuss in groups. Tutorials and seminars help in managing group discussions and sharing opinions, although guidance and expectations to tutors should be given. There is also the option of giving students extra material to read in their own time if interested, with the help of questions to prompt reflection.
3. The **time** we have to develop new resources is tight. There are, however, resources that can be adapted relatively quickly depending on the educator's needs. For example, MacTutor for biographies (O'Connor & Robertson, 2003), YouTube videos like "What Happens When Maths Goes Wrong?" by Matt Parker (The Royal Institution, 2019), articles on slave insurance models on Wikipedia (Wikipedia contributors, n.d.). Other resources available are materials from the "Ethics in Mathematics" Project (Chiodo, Müller and Shah, 2023), the monthly readings and discussions in the History for Inclusion and Diversity in Mathematics Network (more about it later), and, with expected publishing date in 2026, the resource "*A Global History of Mathematics*" on OpenLearn (please, contact Dr Brigitte Stenhouse, The Open University, for more information).
4. The **cohort** of students itself shapes the resources provided. Education has many goals, and we may be trying to encourage within students an appreciation of mathematics and its applications. Starting with a rogue's gallery of problematic individuals and topics might not fit with this aim, whereas students might appreciate more philosophical approaches later in the degree. Also we must consider the purpose for learning mathematics and approaches may differ whether the students are studying mathematics to become mathematicians, or are students of other disciplines coming to use mathematics as a tool.

After the excursus of examples and points of discussions on how to incorporate historical resources in our day-to-day teaching, we ran a 15-minute session on reflection on what has been discussed, where participants were asked either to think of a resource on some challenging topic from the history of mathematics and statistics, that they could include in their teaching, or to think on how to use historical sources in different teaching contexts, how it might be assessed, or what support might be given to students and tutors in having challenging conversation.

3. Underrepresented Mathematicians and Historical Methods in Modern Context

3.1. Showcasing overlooked mathematicians

In this session, we introduced an internship project titled *Using History and Biography to Increase Awareness of Diversity in Mathematics and Statistics* at Maynooth University (2025). Over the summer, four undergraduate students taking modules in service mathematics were recruited and developed a collection of eighteen posters celebrating the lives and achievements of historically overlooked mathematicians and statisticians that the students themselves selected. These resources, in addition to illustrating the diversity of mathematical and scientific contributors, provide links to further materials, such as podcasts and videos. As part of the department's broader commitment to promoting equality, diversity, and inclusion, the posters are displayed on campus, featured on its website, and are currently being incorporated into teaching where possible.

3.2. Historical methods: "algebraic" techniques

Alongside the stories of individual mathematicians, we aimed to show that mathematics is not only a product of the present, but is deeply rooted in human history, diverse cultures, and ingenious solutions that predate modern notation. By exploring a series of classical "algebraic" methods, participants were invited to view mathematics as a shared human endeavour—a tapestry woven from many civilisations.

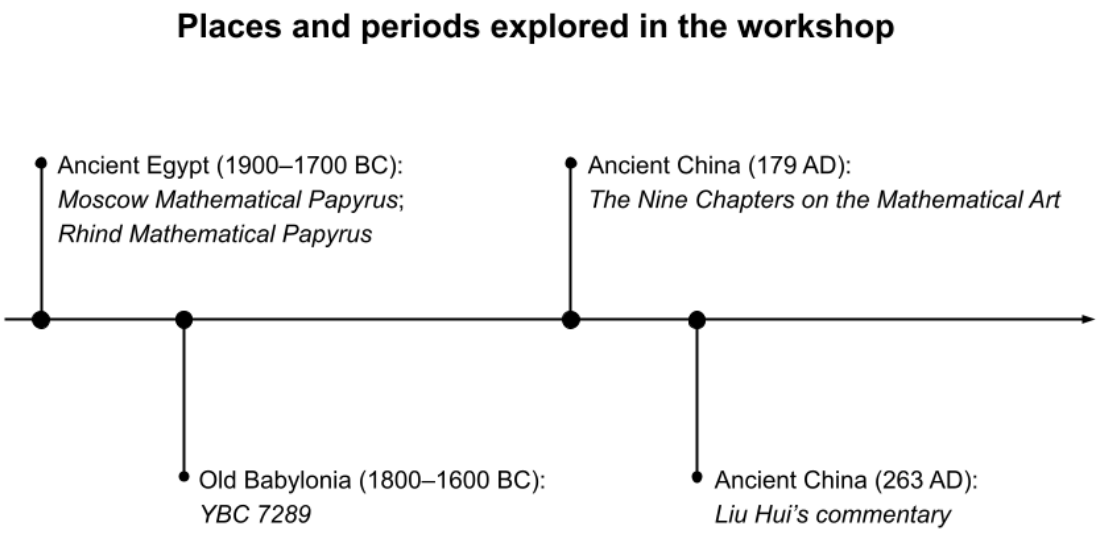

Figure 1. Timeline of the places and historical periods explored in the workshop, from ancient Egyptian and Babylonian sources to classical Chinese mathematical texts and commentaries.

We began in ancient Egypt with *regula falsi* for solving simple linear equations, drawing on Problem 26 from the Ahmes Mathematical Papyrus (Chace, Manning and Archibald, 1927, pp. 68–69) and

Problem 19 from the Moscow Mathematical Papyrus (Katz, 2008, pp. 7–9). From there, we travelled to China’s *Nine Chapters on the Mathematical Art* (《九章算術》), exploring the Method of Excess and Deficit for solving simultaneous linear equations in Chapter 7, together with Liu Hui’s commentary. A ratio table was used to illustrate how excess and deficit balance, and a parallel was drawn with the modern secant method, highlighting the similarity of the underlying concepts despite centuries of changes in notation.

Method of Excess and Deficit and its modern graphical interpretation

(a) Table representation

Trail payment	8	7
Excess / deficit	3	4
Cross product	8 × 4 = 32	7 × 3 = 21
Numerator	32 + 21 = 53	
Denominator	3 + 4 = 7	
Each person pays	53/7	

(b) Graphical representation

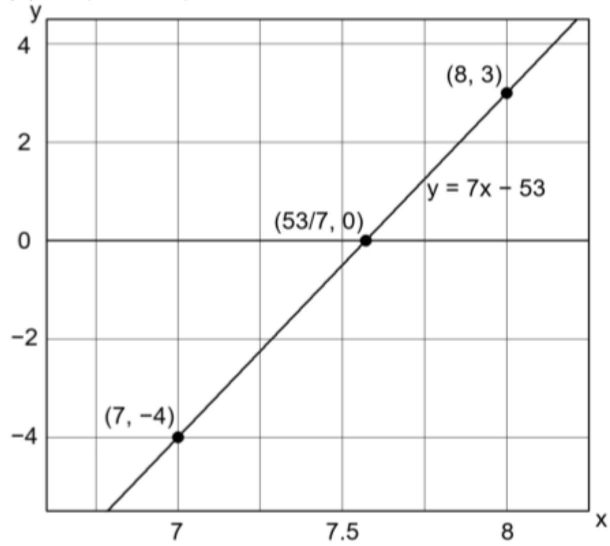

Figure 2. Comparison between (a) the table for Method of Excess and Deficit and (b) its modern graphical interpretation. In (a), two trial payments for each person produce one excess and one deficiency. In (b), the same trial values correspond to the points (7, −4) and (8, 3), whose x-intercept gives the common payment 53/7.

We then moved to Babylonia, examining algorithms for approximating square roots. In particular, we discussed the well-known YBC 7289 tablet, which records the value of $\sqrt{2}$ to six decimal places, demonstrating the remarkable accuracy of ancient numerical schemes (Fowler and Robson, 1998). Participants were guided to rediscover the associated iterative formula by squaring a binomial expression, using only junior secondary level mathematics.

Finally, in a counting-board activity, we simulated a Chinese counting board using animations and paper grids, as the physical board was not available. Quadratic equations were “solved” through the movement of counters (Lam, 1982). To deepen understanding, a geometric justification was provided by partitioning a large square into smaller squares and rectangular strips, allowing the algebraic formula to emerge visually.

Counting-board movement for $x^2 + 35x = 1334$

R_5			2	2	2	2
R_4	1 3 3 4	1 3 3 4	1 3 3 4	1 3 3 4	1 3 3 4	2 3 4
R_3			2		1 1 0	
R_2	3 5	3 5	3 5	5 5	5 5	5 5
R_1	1	1	1	1	1	1
		If $x = 20$	R_3: $R_1\times2$	R_2:R_2+R_3	R_3:$R_1\times2$	R_4:R_4-R_3

R_5	2	2	2 3	2 3	2 3	2 3
R_4	2 3 4	2 3 4	2 3 4	2 3 4	2 3 4	2 3 4
R_3	2			3		2 3 4
R_2	5 5	7 5	7 5	7 5	7 8	7 8
R_1	1	1	1	1	1	1
	R_3: $R_1\times2$	R_2:R_2+R_3	If $x = 23$	R_3:$R_1\times3$	R_2:R_2+R_3	R_3:$R_2\times3$

Figure 3. Table-based visualisation of the counting-board activity used in the workshop. From left to right, the successive stages show how movement and rearrangement on each row support the solution of $x^2 + 35x = 1334$ until $x = 23$ is reached.

The purpose of this tour was not merely historical. Rather, it was to illustrate how revisiting older methods can enrich contemporary teaching practice: mathematics becomes more inclusive when contributions from different civilisations are made visible; students could develop a deeper understanding when they see how methods have evolved over time and recognise structure beneath symbolic form; and, perhaps most importantly, such approaches challenge the myth that mathematics is a purely Eurocentric or ahistorical discipline.

4. Further work

Readers interested in this topic are strongly encouraged to join the History for Inclusion & Diversity in Mathematics Network. This project, supported by the Isaac Newton Institute and others, aims to build a network around using history of mathematics to promote equality, diversity and inclusion in the mathematics curriculum in UK higher education. The Network hopes to tackle the following research questions:

- In what ways are current HE maths curricula experienced as exclusive?
- What examples are there of using history to make the curriculum more inclusive?
- What support do practitioners need in using history to diversify the curriculum?
- How is the effectiveness of such initiatives best evaluated?

Members are not experts in these topics, but people who are interested to explore these ideas and learn. The network is led by Prof Isobel Falconer and further details can be found on the website https://mathshist4edi.wp.st-andrews.ac.uk/

5. Acknowledgements

The authors thank **Andrew Potter** for his contributions to the planning and preparation of the workshop reported in this paper. The History for Inclusion & Diversity in Mathematics Network is supported by the Isaac Newton Institute and the Engineering and Physical Sciences Research Council [Ref: EP/V521929/1].

6. References

American History Foundation, n.d. John von Neumann. Available at: https://ahf.nuclearmuseum.org/ahf/profile/john-von-neumann/ (Accessed: 16 December 2025)

Bradshaw, N. and Mann, T., 2021. Welcoming students to the mathematics community: obstacles to “belonging”, *MSOR Connections*, 19(2), pp. 75–86.

Georgeac, O. and Rattan, A., 2022. Stop making the business case for diversity, *Harvard Business Review*.

Chace, A.B., Manning, H.P. and Archibald, R.C., 1927. *The Rhind Mathematical Papyrus, British Museum 10057 and 10058, Vol. I: Free Translation and Commentary*. Oberlin, OH: Mathematical Association of America.

Chiodo, M., Müller, D. and Shah, R., 2023. *Teaching Resources for Embedding Ethics in Mathematics: Exercises, Projects, and Handouts*. arXiv [preprint], arXiv:2310.08467. Available at: https://arxiv.org/abs/2310.08467 (Accessed: 16 December 2025).

Chiodo, M. and Müller, D., 2024. Why mathematics is not neutral, and other myths, *LSE Higher Education Blog*, 10 October 2024 [Blog]. Available at https://blogs.lse.ac.uk/highereducation/ (Accessed: 16 December 2025).

Ernest, P., 2021. *Mathematics, ethics and purism: an application of MacIntyre’s virtue theory*. Synthese, 199(11), pp. 3137–3167. doi:10.1007/s11229-020-02928-1

Fowler, D. and Robson, E., 1998. Square root approximations in Old Babylonian mathematics: YBC 7289 in context, *Historia Mathematica*, 25(4), pp. 366–378. doi:10.1006/hmat.1998.2209.

Hardy, G.H., 1920. *Some famous problems of the theory of numbers and in particular Waring’s problem*. Oxford: Clarendon Press.

Hardy, G.H., 1969. *A mathematician’s apology*. Cambridge: Cambridge University Press.

Su, F., 2020. *Mathematics for human flourishing*. New Haven, CT: Yale University Press.

Katz, V.J., 2008. *A history of mathematics: An introduction*. 3rd edn. Boston, MA: Pearson.

Lam, L.Y., 1982. The development of polynomial equations in traditional China, *Singapore Mathematical Society Newsletter (Medley)*, 14(1), pp. 22–38. Available at: https://sgmathsociety.org/smsmedley/Vol-14-1/The%20development%20of%20polynomial%20equations%20in%20traditional%20China(Lam%20Lay%20Yong).pdf (Accessed: 16 September 2025).

Maynooth University, 2025. *Increasing awareness of diversity in mathematics and statistics through biography and history*. Department of Mathematics & Statistics, Maynooth University. Available at: https://www.maynoothuniversity.ie/mathematics-and-statistics/EDI-Resources (Accessed: 15 December 2025).

O'Connor, J.J. & Robertson, E.F., 2003. *The MacTutor History of Mathematics archive*. University of St Andrews. Available at: https://mathshistory.st-andrews.ac.uk/ (Accessed: 16 December 2025).

The Royal Institution, 2019. *What Happens When Maths Goes Wrong? – with Matt Parker*. [Online video]. YouTube, 7 March. Available at: https://www.youtube.com/watch?v=6JwEYamjXpA (Accessed: 16 December 2025).

Theories of Race, n.d. *Francis Galton — Theories of Race*. Available at: https://www.theoriesofrace.com/43/ (Accessed: 16 December 2025).

Wikipedia contributors, n.d.. *Sally Clark*. *Wikipedia, The Free Encyclopedia*. Available at: https://en.wikipedia.org/wiki/Sally_Clark (Accessed: 16 December 2025)

Wikipedia contributors, n.d.. *Slave insurance in the United States*. *Wikipedia, The Free Encyclopedia*. Available at: https://en.wikipedia.org/wiki/Slave_insurance_in_the_United_States (Accessed: 16 December 2025).

《九章算術》[*Jiuzhang Suanshu* / *Nine Chapters on the Mathematical Art*], c.1st century BCE, with commentary by Liu Hui, 3rd century CE.