

# **SPACE TOURISM WITH CURRENT TECHNOLOGY FOCUSING ON ISRO**

## **A Project Report**

Submitted in partial fulfillment of the  
Requirement for the award of the Degree  
of

**BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)**

By

**Ashwini Panicker**

**SEAT NO.: 3021252**

Under the esteemed guidance of

**Asst Prof. Ms. Sneha Gokarnkar**

(Coordinator)



**DEPARTMENT OF INFORMATION TECHNOLOGY**

**LAXMI CHARITABLE TRUST'S**

**SHETH L.U.J. COLLEGE OF ARTS & SIR M.V. COLLEGE  
OF SCIENCE & COMMERCE**

*(Affiliated to University of Mumbai)*

**Dr. S Radhakrishnan Marg, Andheri (E), Mumbai – 400 069.**

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# PROFORMA FOR THE APPROVAL PROJECT PROPOSAL

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1. Name of the Student

**Ashwini Panicker**

2. Title of the Project

**Space Tourism with Current Technology Focusing on ISRO**

3. Name of the Guide

**Prof. Sneha Gokarnkar**

4. Teaching experience of the Guide

**21 Years**

5. Is this your first submission?

**Yes** ☐

**No** ☐

Signature of the Student

Signature of the Guide

Date: .....

Date: .....

Signature of the Coordinator

Date: .....

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**CERTIFICATE**

This is to certify that the project entitled, "**Space Tourism with Current Technology Focusing on ISRO**", is bonafide work of **Ashwini Panicker** bearing Seat.No: **3021252** submitted in partial fulfilment of the requirements for the award of degree of BACHELOR OF SCIENCE in INFORMATION TECHNOLOGY from University of Mumbai.

**Internal Guide**

**Coordinator**

**External Examiner**

**Date:**

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# ABSTRACT

The once-fantastical idea of space travel is now becoming a reality due to the quick development of space technology. The sector is dominated by private firms like SpaceX and Blue Origin, but the Indian Space Research Organization (ISRO) is becoming a major force because to its dependable and reasonably priced space missions. With the launch of the ambitious Gaganyaan crewed mission and technologies like the PSLV, GSLV, and RLV, ISRO is well-positioned to contribute significantly to the expansion of access to space tourism. Future partnerships with private companies and global institutions may increase ISRO's participation in commercial spaceflight while promoting improvements in infrastructure, legal frameworks, and environmentally friendly spaceflight procedures. With these advancements, ISRO might democratize space travel by making it more widely accessible while maintaining long-term cost.

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# ACKNOWLEDGEMENT

We would like to express our gratitude to our college SHETH L.U.J. & SIR M.V. COLLEGE OF ARTS, SCIENCE AND COMMERCE who supported us throughout the project building process. We are pleased for the aspiring guidance, invariably constructive criticism and friendly advice during the project work. We are sincerely thankful to all the teachers for sharing their truthful and illuminating views on a number of issues related to the project.

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Many thanks to all whose work, research and support helped me to move forward in our way to make this research.

And finally, a big thanks to our family and friends for continuously being our side support and leading us.

# DECLARATION

We hereby declare that the project entitled, “**Space Tourism with Current Technology Focusing on ISRO**” done at Mumbai, has not been in any case duplicated to submit to any other university for the award of any degree. To the best of my knowledge other than me, no one has submitted to any other university. The project is done in partial fulfillment of the requirements for the award of degree of **BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)** to be submitted as a final semester project as part of our curriculum.

**Ashwini Panicker**

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# CHAPTER 1: INTRODUCTION

A new industry termed "space tourism" promises to combine the adventure of traveling and the great uniqueness of space exploration. Indeed, some private companies and space agencies are attempting to make space even more accessible to the public with improving technology. For instance, the Indian Space Research Organisation had been doing very well with its bold Gaganyaan mission that was supposed to send Indian astronauts into space.

The space agency uses the GSLV Mk III as a launch vehicle that is optimized for crewed missions up to low Earth orbit. Life support equipment and cutting-edge navigation and communication tools are equipped on the Gaganyaan spacecraft to ensure the security and comfort of astronauts. The mission marks a prelude to and an attempt by India to exhibit its prowess in human spaceflight.

ISRO's initiatives have boundless space tourism capability. Commercial space flight infrastructure will evolve as the business community and other organizations outside the nation collaborate with this agency. The outcome would be spaceports, astronaut training centers, and a legislative structure that will ensure safe space travel.

Space tourism also carries serious social impacts. It opens up possibilities for international cooperation, increases interest in space and related science, technology, engineering, and mathematics subjects, and offers a better understanding of our planet from different perspectives. The dream of space tourism gets more real as ISRO develops and ramps up its capabilities, unlocking doors to a whole new chapter of space travel.

## 1.1 BACKGROUND AND MOTIVATION

### **Background:**

Sending private citizens into space for leisure, adventure, or recreational purposes is the idea behind it. Space tourism has become an important frontier in the aerospace industry with increased interest in commercial space flight and technology improvements. Technological advances in rocketry, spaceship design, and expansion in a commercial space industry have made space travel possible.

Known for its economical and efficient space missions, ISRO is going to be one among the few leaders in the development of space tourism. As far as the track record is concerned, ISRO is pretty good at launching satellites and interplanetary missions. ISRO, with its ability to conceive reliable launch vehicles and spacecraft, will be a critical requirement for space exploration in the near future.

## **Motivation:**

### **1. Technological Advancement:**

Having GSLV cut from the very same cloth, and Gaganyaan that is scheduled to be operational in the near future and is going to launch Indian astronauts to orbit, ISRO has gone along leaps and bounds. These developments not only improve the ISRO's image but also set up a major base for future commercial space ventures.

### **2. Prospects for Economic Growth:**

It is also anticipated that the growing disposable incomes and an increasing desire for unique experiences will drive strong growth in the global space tourism business. Joining this market by ISRO can drive further growth in the Indian economy, alongside new job opportunities for hospitality, aerospace, and other relevant industries.

### **3. Inspiration and Public Involvement:**

Space tourism could be a very good tool for the involvement of the public and can stimulate an inspired new generation of scientists, engineers, and enthusiasts of space. ISRO may open access to space so that young minds are encouraged to seek professions in the STEM (science, technology, engineering, and mathematics) disciplines.

### **4. International Cooperation:**

Space tourism would bring about opportunities for cross-border partnerships and collaborations. In the long run, collaboration between ISRO and corporate ventures and other space bodies will benefit the global fraternity of space as it will share resources and widen the skill base in technology.

### **5. Research and Sustainability:**

Space tourism also opens up possibilities for scientific investigation in microgravity environments, and with it may come discoveries in several fields: environmental studies, materials science, and medicine, all of which could support sustainable practices on Earth.

### **6. Cultural and national pride**

In fact, it can become another area of pride for India in that regard as it continues to make its mark in the international space arena. Success of its missions would help that nation foster among its people a sense of accomplishment and togetherness, as India stands among those pioneering nations in space exploration and innovation.

## **1.2 OVERVIEW**

Space tourism is one of the emerging sectors that have picked up a great deal of steam lately, driven by technological advancement and more corporate involvement on behalf of state-owned space agencies. ISRO has been one of the leading organizations in creating technology that may eventually make it possible form travelling to space.

### **Current Scenario of Space Tourism**

#### **1. Technological Advancements:**

Due to advancements in rocket technology, spaceship design, and safety procedures, space travel has become the practical mode. Space travel for both suborbital and orbital travel will be the pioneers of a booming industry for space tourism initiated by groups like SpaceX, Virgin Galactic, and Blue Origin. These developments are also impacting the research conducted by ISRO for tourism and human spaceflight.

#### **2. ISRO's contributions:**

With interplanetary missions and launching satellites, ISRO has made several breakthroughs in space technology. However, with the latest attempt at human space flight with the Gaganyaan program, it may seem like a capability shift toward space tourism and other forms of commercial activity by ISRO, for all practical purposes, its focus has still been on research missions. Under the Gaganyaan program, the target of Indian astronauts reaching low Earth orbit may open up opportunities for future space tourism ventures.

#### **3. Infrastructure Development:**

Spaceports and allied infrastructure development are considered imperative steps in further widening space tourism. Commercial space flight can be accommodated at ISRO's present launch facilities, and partnership with the private sector may enhance these capacities. Construction of spaceport would make the process easier for launch and landing of spacecraft meant for tourist voyages.

#### **4. Rules and Safety:**

For space tourism, safety will always come first. The ability of ISRO to create good safety procedures to its flights can contribute significantly to forming the legal framework that would be required for commercial space flight. For this, passenger safety throughout launch and flight and a safe re-entry is part of it.

## **5. Market Potential:**

A vast cross-section, from researchers to educational institutes and from adventure enthusiasts among the rich, are likely to drive the growth curve of this industry for space tourism. With its impressive launch technology, ISRO's involvement may just make things happen within a cost curve that degrades slowly enough to democratize access to space. Making things more inclusive than exclusive.

## **6. Future Outlook:**

With ISRO on board, space tourism may eventually offer extended stops over low Earth orbit or suborbital flights that would give passengers a brief feel of the weightlessness sensation. Travel packages for space hotels or lunar tourism may be fashioned from partnerships with private space enterprises.

# **1.3 RESEARCH GOALS AND APPROACH**

Space tourism research focuses on addressing many important issues in this context, considering the modern technologies now being designed under the aeg of ISRO along with other organizations.

## **Objectives of Research**

### **1. Technological Development:**

The goal of development is mainly to produce the tools required for safe and effective space travel. This is meant to be as far-reaching as establishing reliable spacecraft, launchers, and life support systems that will enable humans to stay in the space environment for extended periods.

### **2. Cost Reduction:**

One of the primary goals is to reduce the cost of space travel. ISRO and other agencies should come up with new launch technologies and reusable spacecraft so that journey into space could be more accessible and affordable for the greater portion of the segment.

### **3. Safety and Reliability:**

Passengers' safety has to be of topmost importance. The study of ways and means by which the risks associated with space flight can be cut focus upon safety measures, emergency response mechanisms, and general reliability of spacecraft.

### **4. Sustainability:**

The need to create sustainable space tourism practices is growing day by day. It means that research is aimed at finding ways of utilizing in-situ resources available within space and launches should have a minimal impact on the environment.

### **5. Public Engagement and Education:**

Another is to spur public interest in space travel and exploration. This comprises outreach and education services to inform people on the advantages and potential applications of space travel.

## **Research Method**

### **1. Collaborative Innovation:**

In an effort to access a wide range of resources and expertise, ISRO often collaborates with educational institutions and private companies. Cooperative strategy enhances innovativeness and accelerates new technologies development.

### **2. Incremental Testing:**

This step-by-step process sends technology through thorough tests. As part of it, this involves undertaking several suborbital and orbital test flights to collect data and push forward technology before large-scale business implementation.

### **3. Simulation and Modeling:**

Complex variables involved in space travel, such as spaceship dynamics, comfort for passengers, and effects on the environment, are simulated using advanced modeling techniques. The models facilitate the prediction of outcomes and optimization of design.

### **4. User-Centric Design:**

In the case of research for the spacecraft design, the entire experience ought to be able to meet customer expectations and, therefore, takes into account prospective space tourist input. This includes traveling comfortably, being accessible, and enjoying the experience.

### **5. Development of the Regulatory Framework:**

With the rapid development of space tourism, it will be essential to be regulated by a clear legal framework. Thus, the current study falls under the broader research process that seeks to investigate the legal implications surrounding space tourism, including its safety regulations, liability, and space traffic control.

### **6. Improving Public Outreach:**

The research objectives and strategies regarding space tourism, specifically within the context of ISRO's existing technologies, target increased public outreach, sustainability, reduced cost, and improved safety. Methods are collaborative and iterative in nature.

## CHAPTER 2: LITERATURE REVIEW

- [1] **A. Yazıcı and S. Tiwari** explains that there has been a sharp increase in the number of people involved in space activities since 1957, when Sputnik 1, the first artificial satellite, was launched. Even though space tourism is still in its infancy, it is predicted that in the upcoming years, there will be a major increase in the number of space travelers. Humanity has benefited greatly from space flight, and a new era when space will be open to the public is beginning. Space industry heavyweights like SpaceX, Virgin Galactic, Blue Origin, Orion Span, and others are attempting to turn the tide on space operations by presenting the idea of space tourism to the general public.

Space industry heavyweights like SpaceX, Virgin Galactic, Blue Origin, Orion Span, and others are attempting to turn the tide on space operations by presenting the idea of space tourism to the general public. This article reviews the history of human spaceflight, the definition of space tourism's objectives, and the various projects created by various businesses to enable commercial spaceflight. Three subcategories have been added to the concept of space tourism in this article: sub-orbital space tourism, orbital space tourism, and beyond Earth orbit tourism, which is the area where businesses like SpaceX and Space Adventures Ltd. push the envelope.

- [2] **W. Mendell, A. Bukley** summarizes a student design project that was carried out in Valparaíso, Chile during the 2000 Summer Session of the International Space University. The study looked at both present and potential futures for space tourism. The research addressed every possible aspect of the enormous array of problems and variables that need to be taken into account when predicting the emergence of commercial space flight. The technologies that were looked at included affordable and easily accessible space travel, as well as suborbital and orbital space travel, space facility development, and facility management.

The specifications for life support systems as well as the physical and medical needs of the travelers were taken into account. The question of what kind of accommodations and entertainment would be desired was also addressed, along with how long a typical excursion into orbit would take to plan and execute, as well as whether any physiological follow-up activities would be necessary. Aspects such as human safety, risk factors, policy consequences, legal and liability issues, and social and cultural expectations were evaluated in addition to business potential.

- [3] **V. Smith** has conducted research showing how a century of advancements in mass tourism and aviation technology have altered our perspective of the world. Our travel range has expanded and trip times have decreased as a result of faster transportation relative to distance. Humanity has traversed the planet, ascended its tallest peak, and descended into the ocean. Our final "frontier," space, is the next travel obstacle. The development of technology to enable travel and eventually life beyond the earth's atmosphere, the encouragement of the social sciences to keep pace with scientific advancements in astrophysics, space medicine, and aeronautics, and the pursuit of international consensus regarding the habitation and

development of cosmic space are the three main scientific challenges of the 21st century travel frontier.

The current situation of space tourism at the turn of the millennium, historical factors that gave rise to a market capable of accommodating a million or more people, and certain medical and psychological concerns of extraterrestrial hosts and visitors are all covered in this article. For the first time, a "host population" will be developed to staff hotels, and at first, "guests" will need to pass a screening process to determine their suitability for "touring."

[4] **C. Cater** has carried out an investigation that documents the growth of the noteworthy terrestrial space tourism market, encompassing zero-gravity flights, launch tours, dark-sky tourism, and edutainment activities, as a means of preparing for more expensive future space tourism advances. The next rung on this product ladder is the recent advancements in the suborbital sector, driven by Virgin Galactic and the XPRIZE. All of them take inspiration from the rich past of space exploration—real, virtual, and imagined—which helps to define how future advancements in space tourism might be perceived.

[5] **TM. Khan and Mohammad Yaseen Malik**, describes any business that offers clients experiences in space travel, whether direct or indirect. Such activities include extended stays in orbital facilities, brief flights in orbit or suborbital space, and even parabolic flights in which passengers experience moments of weightlessness. Private space travel is becoming more and more popular with the general populace. Although there are currently no chartered flights available, "space tourists" have occasionally taken orbital flights. So far, seven "space tourists" have been sent to the International Space Station ("ISS"), all of whom have been charged a large sum of money for their participation. I have tried to explain space tourism in a way that is understandable and straightforward in this work.

This paper delves deeply into the concept of space, space stations, and the specifics of the first space station. I also discussed space tourism's development and history in my research paper. The advantages and disadvantages of space tourism are also covered in this essay. Furthermore, I have endeavored to examine the effects of space travel on humankind in addition to the growth and prospects of space tourism.



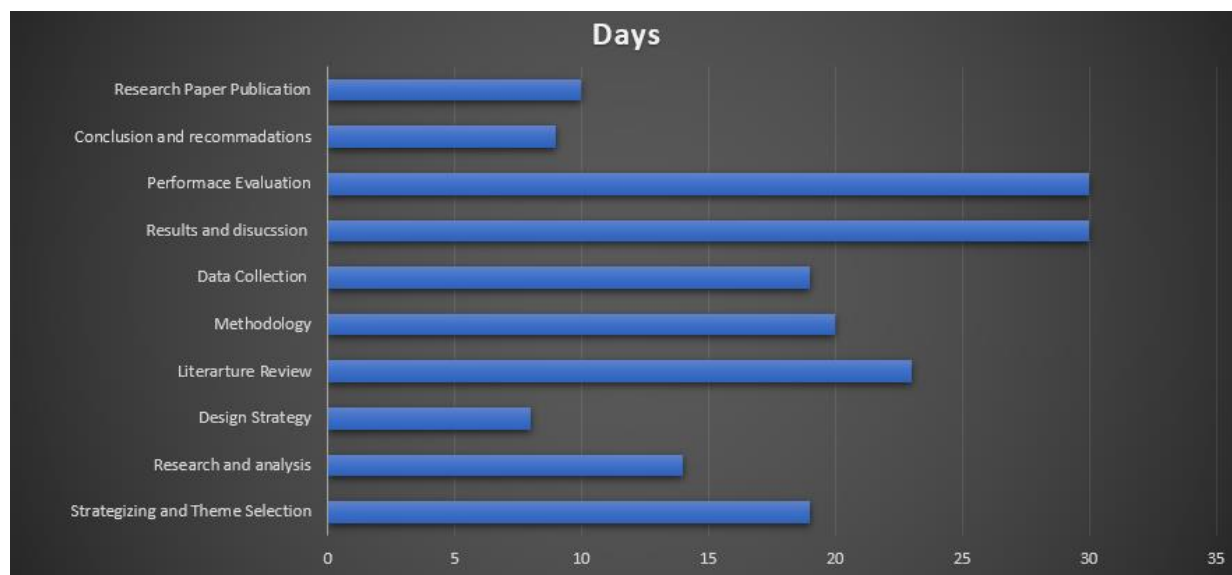
# CHAPTER 3: ARCHITECTURE AND DESIGN

## 3.1 Design Strategy

### 3.1.1 GNATT CHART

A Gantt chart is the representation of the schedule of tasks in a project management tool. It helps to break up complex projects into workable jobs by giving the starting and ending dates for each activity, together with its duration. The "Space Tourism with Current Technology" Gantt chart illustrates with definite deadlines the phases of project - planning, research, design, and data gathering. The Gantt chart shows how the process flows and what the dependencies of the tasks are and ensures that the project moves fast toward the ultimate goal.

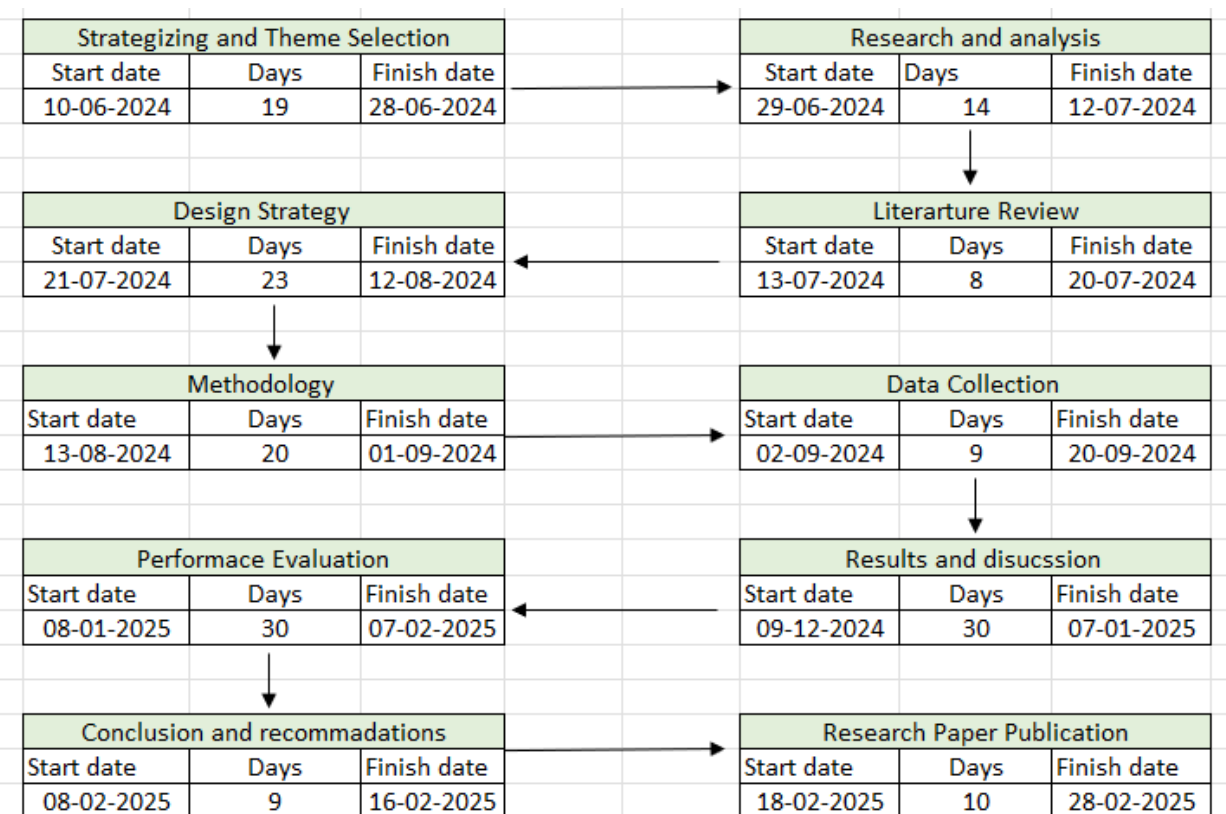
Task	Start date	End date	Days
Strategizing and Theme Selection	10-06-2024	28-06-2024	19
Research and analysis	29-06-2024	12-07-2024	14
Design Strategy	13-07-2024	20-07-2024	8
Literarture Review	21-07-2024	12-08-2024	23
Methodology	13-08-2024	01-09-2024	20
Data Collection	02-09-2024	20-09-2024	19
Results and disucssion	09-12-2024	07-01-2025	30
Performace Evaluation	08-01-2025	07-02-2025	30
Conclusion and recommadations	08-02-2025	16-02-2025	9
Research Paper Publication	18-02-2025	28-02-2025	10



### 3.1.2 PERT CHART

A PERT (Program Evaluation and Review Technique) chart is a tool used for planning, scheduling, and coordinating in a project management process. It visually describes the process, indicating the sequence or order in which tasks must be done, including the dependencies between those tasks, regarding their timeliness. Attached here is a PERT chart of "Space Tourism with Current Technology," but each activity was further broken down into specifics such as start dates, end dates, and durations. Using a chart that depicts dependencies and important paths between tasks, you can identify delays in a task and take the necessary steps for not letting it turn into a domino effect on the project's timeline.

Task	Start date	End date	Days
Strategizing and Theme Selection	10-06-2024	28-06-2024	19
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## 3.2 PARAMETRIC ANALYSIS

### 3.2.1 Google Scholar

Google Scholar is one of the most sensitive and efficient ways that anyone can undertake a literature review. Given its massive database of scholarly articles and advanced search features, it is the best resource a researcher can have.

The following are some of the benefits making use of Google Scholar.

- **Comprehensive Coverage:** Google Scholar covers a wide range of academic literature, including peer-reviewed articles, conference papers, and dissertations, thereby ensuring that researchers have access to a very diverse and comprehensive pool of relevant sources.
- **Advanced Search Features:** The advanced features in this search engine, including Boolean operators and citation tracking, enable the researcher to narrow down the searches and pinpoint key publications in their field.
- **Accessibility:** Google Scholar is accessible from any computer connected to the internet, thus making it open and democratized scholarship access.
- **Citation Analysis:** The capacity of the platform to track citations helps a researcher single out influential works, understand research trends, and place their own research in the larger scholarly context.
- **Integration with Citations Management Tools:** Google Scholar can be easily integrated with most citation management tools, such as Zotero, Mendeley, and End. This ease simplifies the collection and organization of references.

Google Scholar can make literature review easier to achieve by fasten discovery and sourcing the right references for a study.

### 3.2.2 Google Form

Google Forms is an easily accessed survey site, rich in features and effective and adaptable to do researches. Researchers may come up with an appropriate design of the survey with its friendly interface as well as flexible templates that meet the requirements of the researchers, and data collecting and analysis are made much easier with its seamless integration with Google Workspace.

The great ease with which Google Forms can be accessed by survey respondents, whether or not they use any internet-connected device, to fill out surveys using them, means that no special software or accounts are required. In this way, access is absolutely ensured to a representative sample with diversity and also guarantees higher participation rates.

In fact, Google Forms offers lots of capabilities in administering and distributing surveys. This link to a survey may then be shared by the researcher over email, social media, and website embedding with several other means. Flexibility increases the potential reach and allows for tailored outreach for more opportunities to maximize potential utility.

Other than its user-friendliness and accessibility, Google Forms presents solid analytical capabilities. Researchers can create reports of their interest, track in real-time the status of surveys, and evaluate data either by importing data into other programs or using the built-in facilities. The information can be easily analyzed meaningfully, thus processing data effectively.

Overall, Google Forms is a comprehensive solution when conducting research questionnaires. Due to its abundant features, wide accessibility, and ease of use, it is absolutely perfect for researchers to find an efficient way of taking data.

### **3.2.3 Microsoft Excel**

The familiar interface familiar to many with MS Excel will also facilitate the case of those who are not familiar at all with specialized statistical packages. By virtue of this wide distribution, other colleagues and partners have access to the program; hence, co-authors find it easier to share and collaborate on research projects.

Excel has a myriad of tools and procedures that are well suited for easy statistical analysis. Among the examples is the use of the SUM, AVERAGE, and COUNT functions to usually arrive at descriptive statistics.

The ability to chart data also helps in making a visual graphics that can be used in order to better present the patterns and trends that may prevail in the data.

Thanks to the flexibility of Excel, this software can be adapted for use in a variety of research work, from small questionnaires to huge datasets.

This allows users to import data from external sources, clean, and run studies specifically tailored towards their research concerns using the sorting and filtering features of Excel.

Customized formulas and macros allow for complex analysis and for automating repetitive tasks.

### **3.2.4 Microsoft Word**

Probably the most frequently used word processing program in the world, and for all intents and purposes, "user friendly" in terms of functionality, though great for writers whether or not they are freshmen to masters using the software. The power behind the allure of Word is that it has the capacity to allow users to generate well-structured documents because it allows for many text formatting capabilities. Adjusting font styles, sizes, colors, and layouts makes the users' papers look professional and easy to read.

The ribbon across the middle of the program interface has organized tools into tabs such as Home, Insert, Layout, and Review. Such categories have made it easier to access different functionalities required during the creation of the document. Word provides many more advanced features to an end user who is developing more complex documents, such as photograph support, shapes, SmartArt, and control over layout for an entire page as well as the ability to insert tables and charts. Using the above tools, an end-user can come up with exquisite and functionally correct reports, business plans, essays at the college level, and much more.

Another important benefit that Microsoft Word offers is that it interacts quite well with other applications of the Microsoft Office suite. For instance, Word and Excel share a good integration, thereby allowing hyperlinking or embedding spreadsheets into one's papers. This mostly finds application in reports where real-time data changes are required. It also offers an integration with SharePoint and OneDrive to allow people to collaborate in real time with other users. This feature of simultaneous editing and commenting on the same page is excellent for teams collaborating to get a project done.

#### **Word Editing Capability**

Word offers powerful editing features, which allow for quicker and easier revision. Collaborative work is aided with features, such as Track Changes and Comments, that help one easily identify who has made specific changes and how to comment within the text itself. To ensure that the material is polished and businesslike, Word also has an effective spell and grammar checker besides other resources such as a thesaurus and translation services. Its ability to handle citations, references, footnotes, and bibliographies is pretty helpful for

academic writers and researchers, which enables them to easily keep up with several citation styles such as APA, MLA or Chicago.

Besides, Microsoft Word provides many exports and sharings opportunities. Users can save documents in various formats, of course, PDF, which will retain formatting when shared. This becomes important for papers to be read across several platforms without the chance of layout alteration. Word does provide several options which are customizable for individual requirements, such as to print out superior copies of reports, send files via email, and share files over cloud services.

Briefly, any one who involves in frequent generation and alteration of documents should have Microsoft Word. Its ideal integration with other tools, brilliant combination of complex features with ease makes it highly apt for solo as well as group endeavors. Word provides a wide platform to create modernized, sleek high-end documents-from basics in simple text formatting to handling complex layouts.

### **3.2.5 Grammarly**

Grammarly is one of the most popular digital writing assistant software aimed at improving the quality of written materials through comprehensive checks for grammar, spelling, and style. It offers more significant recommendations regarding the improvement of clarity, coherence, and readability apart from standard proofreading abilities that most software word processors provide. Ease of integration and accessibility are primary reasons for its wide popularity. Grammarly is versatile and easy to implement in routine writing tasks because one can apply it as a desktop application, mobile app, or browser extension. It provides instantaneous feedback while working on projects such as emails, reports, or social media posts. It does this by easily integrating into many different channels.

Grammarly primarily checks for basic spelling and grammar errors but provides recommendations for enhancing tone, punctuation, and sentence flow. Writers who write with the intent of sounding formal, friendly, or persuasive might find its tone detector tool particularly useful in helping to zero in on which audience to concern themselves with their message. Unlike other grammar checkers, Grammarly has a level of contextual knowledge. It also provides ideas on how the language can be improved by changing frequent words into alive, interesting words that make writing look polished and interesting.

Another important feature of Grammarly is its capability to check consistency with regards to style. It helps the writer maintain uniformity of writings on issues related to capitalization, voice, and usage of tense in the entire work. This comes in particularly handy when drafting lengthy reports or scholarly papers, where professionalism calls for predictability. Beyond that, Grammarly also gives a readability score that lets the users know the ease or difficulty of their writing for a target audience to understand. This allows writers to adjust their vocabulary or sentence construction according to the readers' level of understanding.

Grammarly's reputation is partly due to its ability to offer feedback tailored toward individual preferences. The software will learn over time the habits and mistakes of writers as it is being used by them, after which it will offer recommendations based on customization to help the users improve in that or those areas. For example, the Grammarly software will teach the user to learn from his mistakes so as not to commit the same fault again in the future while committing some grammar mistake repeatedly; it will flag more than that; it will also state why it is wrong.

Grammatically, the premium version is only meant for professionals and scholars' use and comes with advanced features like plagiarism detection that cross-references millions of internet sources to confirm its originality. This would be particularly helpful to students, researchers, and professionals who will need their work unique and correctly referenced. More detailed writing guidance, like ideas on clarity and conciseness improvement along with engagement are part of the premium version.

Grammarly is therefore a full writing tool enabling users to generate effectively polished, error-free contents. In this regard, it is an inevitable tool in the service of any individual trying to improve his/her writing skills, such as plagiarism detection, contextual tone and style recommendations, and real-time grammar and spelling checks. With Grammarly, you have an easy-to-use user-friendly and efficient means of honing your writing skills on various platforms, no matter the level of experience one might be accustomed with in writing.

### **3.2.6 Quitbot**

QuitBot is an innovative AI-powered digital health assistant designed to support individuals on their journey to quit smoking. Developed by the Fred Hutchinson Cancer Center, QuitBot leverages over two decades of behavioral science research integrated with conversational artificial intelligence to deliver personalized, supportive, and evidence-based interventions for tobacco cessation. Unlike traditional cessation tools, QuitBot is specifically structured to provide users with consistent encouragement and practical strategies through engaging and brief interactions.

One of QuitBot's most notable strengths lies in its structured two-phase program, which includes 14 days of preparation before the quit date and 28 days of support afterward. This clear and supportive timeline helps users build readiness and resilience during the most critical periods of their quitting process. QuitBot offers actionable advice on how to manage cravings, cope with withdrawal symptoms, and deal with common triggers. Through natural, conversational exchanges, it educates users about the use of FDA-approved medications and techniques that improve success rates.

What makes QuitBot uniquely effective is its interactive and empathetic conversational style, which keeps the user engaged without becoming overwhelming. The app is designed to simulate a brief chat, taking only 3–5 minutes of the user's time per day, making it highly manageable for those with busy schedules. These micro-interactions are scientifically structured to reinforce positive behavior and minimize relapse risks.

In addition to smoking cessation, QuitBot offers tailored feedback that adapts based on user responses. It maintains a human-like tone that feels supportive rather than robotic, which can be

especially important during moments of vulnerability or stress. The app learns from user behavior over time, offering personalized suggestions based on progress, challenges, or frequent patterns of relapse, thus encouraging accountability and motivation.

QuitBot's accessibility across Android and iOS platforms adds to its appeal. Users can easily download the app and begin their quit journey without the need for in-person consultations or complex sign-ups. The lightweight and non-intrusive nature of the app ensures it can be used discreetly and efficiently.

Moreover, QuitBot's effectiveness is backed by research. In clinical trials, it demonstrated a higher-than-average success rate in helping users quit smoking compared to traditional methods. This positions it as not just another health app, but a credible and research-backed tool for behavioral change.

In summary, QuitBot is more than a simple reminder app—it is a **compassionate digital companion** for smokers looking to make a meaningful lifestyle change. With real-time support, adaptive learning, and scientifically grounded advice, QuitBot is a must-have for anyone seriously considering quitting smoking. Whether you're taking your first step or trying again after a relapse, QuitBot offers a user-friendly, intelligent, and reliable path to a smoke-free life.

### 3.3 Sensitivity and Uncertainty Analysis

Space tourism has been driven by significant advances in the field of space technology. But any new and complex venture is bound to be susceptible to numerous unknowns and delicate elements that would affect its further course of development. These elements can impact the cost, safety, feasibility, and scalability of space tourism in the context of the technology presently available.

This section analyzes sensitivities and uncertainties regarding space tourism, keeping a watchful eye on technologies developed by organizations like ISRO (Indian Space Research Organization) and more.

#### Sensitivity Analysis

Sensitivity analysis assesses the change in influential input variables that result in different outcomes for space tourism efforts. Some variables include cost, safety, technological preparedness, environmental impacts, and market demand.

- **Launch Cost:** The launch cost is one of the single biggest drivers for space tourism. By using RLV and good designs like PSLV, organizations like ISRO could seriously reduce the cost of launch. Any increase in cost on energy, raw materials, or even supply chain disruption would result in a critical effect on affordability. It is thus very essential to understand sensitivity of ticket price and market access to changes in cost.



- **Safety Procedures:** Though safety is the first concern in space tourism, it differs slightly from its previous counterpart. For example, correctness in crewed missions going into space and dependability or failure rates of the spacecraft are pretty critical and may have major accidents. Because any mishap may have grim implications on the market, such issues, therefore, have extreme sensitivity. Organizations taking up Gaganyaan and similar projects like ISRO know how crucial accuracy is while dealing with emergency systems, testing a space vehicle, and astronaut training.
- **Technology Readiness:** of particular ones such as crewed capsules, space habitats, and reusable launch vehicles is the most important aspect. If ISRO's RLV or heat shields for re-entry are known to have malfunctioned in case of critical technology, then travel schedules may get delayed or expenses may soar high. The credibility of the mission will get significantly compromised, and investor confidence will also be quite shaken.
- **Ethical and Environmental Considerations:** Public and regulatory sensitivity to environmental factors, such as carbon emissions and space debris, is increasing. Any increase in international environmental regulations could result in increased costs for businesses and organizations, including ISRO, through the requirement for eco-friendly propulsion systems or new orbital debris mitigation technology.

### Uncertainty Analysis

Uncertainty analysis refers to the unpredictability and possible hazards in space tourism. Such uncertainties are brought about by market, political, economic, and technical factors that can pose a strong impact on space tourism.

- **Technical Uncertainty:** It only remains to be seen as to how reliable are the space technologies developed in today's space age. RLV and its crewed spaceflight technology, like Gaganyaan, because of their under development nature, their long term performance is uncertain. Atmospheric re-entry frequently will bring such wear and tear; who knows if these systems may perform reliably and with safety across a few flights.
- **Economic Viability:** Space tourism is vulnerable to uncertain factors regarding financial feasibility, which is related to changes in market demand, ticket prices, and the cost of space infrastructure. Profitability would be vulnerable to the unknown trajectory of growth for the development of spaceport, training facility, and support systems. The uncertainty of inflation rates, international transportation, and all kinds of linkages in supply chain makes this situation worse.
- **The Regulatory Framework:** The legal and regulatory issues in space tourism cut across matters like air space governance, liability regarding space, and astronaut health and safety law. Whether international norms can change quickly and how it will affect the worldwide and regional industries in space tourism is

unknown, especially in countries like India, whose policy being domestically implemented might change ISRO's engagement.

- **Demand and Public Perception:** Demand for space tourism is still relatively unknown despite all the media attention it has recently experienced. If public interest in space tourism is dampened by prices, safety considerations, or environmental effects, it may become difficult to make a case for additional funding for businesses and organizations involved in space tourism. External shocks such as recessions or infamous tragedies can have a huge impact on demand in a market and lead to sudden changes in consumer behavior.
- **Impact on Environment:** It is yet to be known how the increased launches might affect the environment. International standards will perhaps also harden due to increased scrutiny of space pollution such as orbital debris or rocket emissions that air pollute. What remains unknown is when and in what form these standards would be enforced, and how they will shift the cost framework of initiatives in space tourism.

### **Mitigation Strategies for Sensitivity and Uncertainty**

- **Cost Management:** The organizations such as ISRO must focus on re usability technology developments and cost-sharing agreements with private space companies to reduce cost sensitivity. Sensitive dependence of cost on global prices can be diminished by reducing the dependence on expensive resources with help of local supply chains and production.
- **Safety Improvements:** If there are sensitive hazards, then significant investments in safety procedures and testing could ensure the large hazards were reduced in sensitivity. Effects of unscheduled failures would thus be diminished if there was redundancy for critical spacecraft systems, and emergency response plans would be made available.
- **Flexibility and Technological Redundancy:** The above un-certainties can be approached in designing flexible systems with technological redundancy. Thus, for example, the ISRO designing of launching vehicles, namely disposable as well as reusable launch vehicles will provide more elbow space in terms of responding to market shift or technological failures in a particular area.
- **Regulatory Engagement:** The uncertainty of the regulations of space can be reduced through engagement with the regulatory agencies at the earliest. This engagement with national and international regulatory agencies might work towards comprehensive regulations for space tourism, which can better aid in forecasting legal issues and bringing advancements in technology within lines before the rules are implemented.
- **Consumer Engagement and Market Research:** Demand uncertainty can be reduced through in-depth market research, generating public interest by various media and educative initiatives. If there is a better understanding of the tastes and worries of would-be space travelers, agencies like ISRO will be better able to customize their offerings.

# CHAPTER 4: METHODOLOGY AND PROPOSED SOLUTION

## 4.1 Validation of Modeling Techniques

Validation of modeling techniques for space tourism is said to encompass advanced integration of computational models, simulation environments, and data analytics using current technology. As a newly opened field, there are many factors-safety, customer experience, economic viability, and environmental impact-that have to be considered through modeling techniques.

1. **Models can be developed using different modeling techniques:** System dynamics models, agent-based models, and discrete event simulations. These models enlighten the complex interactions between different actors within the space tourism ecosystem from pre-launch, in-orbit experience, to return to Earth.
2. **Safety and Risk Assessment:** Since risks are integral to space travel, the model validation in terms of safety protocols and risk management processes becomes critical. Models such as fault tree analysis and failure mode effects analysis could be interfaced into the modeling framework for analyzing potential failure points and their corresponding safety impacts.
3. **Consumer Experience:** The techniques from behavioral economics and psychology can be used in order to model the experience of a consumer within space tourism. The user experience, combined with the experience of using it, has been made use of in simulating the fine-tuning of the design of the spacecraft and the journey itself. Comfort, entertainment, and educational content can all be modeled to better position the offers of space tourism.
4. **Economic Modeling:** This economic viability is very important for sustaining the space tourism venture. Models can include cost analysis, pricing strategy, and market demand forecasting in it. The techniques like Monte Carlo simulation might be applied to estimate financial risks and returns of the investment under an assortment of scenarios.

5. **Environmental impact:** The space tourism environmental implications must also be modeled. The carbon footprint and other ecological impacts of traveling in space are among the things that can be used to evaluate through techniques such as life cycle assessment (LCA). It's something growing much more significant as stakeholders are coming under pressure to balance the commercial with sustainability considerations.
6. **Technological Integration:** The modeling techniques can be enhanced by the up-to-date technologies: AI and machine learning. Predictive analytics can provide up-to-date data, which improves decision-making at large by constantly analyzing vast datasets of previous space missions as well as customer feedback.
7. **Validations and Testing:** Their validity is achieved through extreme testing against real-world data and scenarios. This can be through pilot missions, simulations, or user feedback loops. It will aid in continuous iteration based on empirical data toward the refining of the models toward better accuracy and reliability.

## Setting the Hypothesis

**Null Hypothesis(H<sub>0</sub>):** Space tourism will not be booming in the coming decades.

**Alternative Hypothesis(H<sub>1</sub>):** Space tourism will be booming in the coming decades.

## Hypothesis Testing

It is an essential approach of research, as one can know whether the information collected from a sample supports specific assertions or assumptions through hypothesis testing. It is statistical procedure for testing the truth of some claims about the population's characteristics by using sample data. A second name that has been given to this approach is the "test of significance," through which statistical hypotheses are made with great knowledge. A hypothesis can be accepted or rejected based on thorough statistical analysis, although it cannot be confirmed with absolute certainty.

## Types of Hypotheses

There are two main categories of hypotheses in research:

### Hypothesis for Research

A research hypothesis is a tentative solution or explanation of a research problem. It guides the researchers in their investigation and serves as the foundation for scientific inquiry. Such a hypothesis is tested through empirical study and is developed from theoretical assumptions or prior studies.

A claim about population parameters that may be tested using statistical techniques is called a statistical hypothesis. It is framed in a manner that allows objective testing and data analysis.

## Types of Statistical Hypothesis

By and large, there are two types of statistical hypotheses:

### Hypothesis Null ( $H_0$ )

The null hypothesis is the claim that there is no relationship, no impact, or no difference between variables. It assumes that any changes in the data seen are the result of chance rather than a real link. In hypothesis testing, the null hypothesis is the default assumption and is only disproved in the event that there is enough evidence to the contrary.

### Hypothesis Alternative ( $H_1$ )

The alternative hypothesis is that the variables are meaningfully related or different. It contradicts the null hypothesis and indicates that the effect observed is not a matter of chance but an actual phenomenon. The alternative hypothesis is taken when statistical data reveals that the null hypothesis is unlikely to be true.

## Questions:

### Exploring Space Tourism: Application and Health Assessment

Thank you for your interest in space tourism! To ensure your safety and well-being during the journey, please fill out the following health-related questionnaire. Your responses will help us assess any potential risks and ensure the best possible experience.

\* Indicates required question

Full Name (First name, Middle name, Surname) \*

Your answer

Age \*

- ☐ Under 18
- ☐ 18-29
- ☐ 30-39
- ☐ 50-59
- ☐ 60 and above
- ☐ Other: \_\_\_\_\_

Gender \*

- ☐ Male
- ☐ Female
- ☐ Other

Do you have any existing medical conditions?(If yes, then specify) \*

Your answer \_\_\_\_\_

Have you undergone a cardiovascular or respiratory fitness test in the last year? \*

- ☐ Yes
- ☐ No
- ☐ Not Sure

Do you have any known allergies?(If yes, then specify) \*

Your answer \_\_\_\_\_

Are you prepared to undergo medical training to manage the effects of microgravity (e.g., motion sickness, disorientation)? \*

- ☐ Yes
- ☐ No

Do you have any prior experience in extreme environments (e.g., deep-sea diving, high-altitude trekking)? \*

- ☐ No
- ☐ Yes

Do you have a history of any of the following conditions? \*

- ☐ Heart disease
- ☐ High blood pressure
- ☐ Diabetes
- ☐ Respiratory disorders (e.g., asthma)
- ☐ Neurological disorders
- ☐ None of the above

Are you willing to participate in follow-up health assessments after your space journey? \*

- ☐ Yes
- ☐ No

Are you familiar with ISRO (Indian Space Research Organisation)? \*

- ☐ Yes
- ☐ No

What excites you most about the idea of space tourism? (Select all that apply) \*

- ☐ Experiencing weightlessness
- ☐ Seeing Earth from space
- ☐ The adventure of space travel
- ☐ Contributing to scientific research

Would you be interested in participating in a space tourism trip organized by ISRO \*

- ☐ Definitely
- ☐ Possibly
- ☐ Definitely not

What are your biggest concerns about space tourism? (Check all that apply.) \*

- ☐ Health risks
- ☐ Safety hazards
- ☐ Environmental impact
- ☐ Cost
- ☐ Unknown factors

What would be your ideal space tourism experience? (Check all that apply.) \*

- ☐ Short duration (a few days)
- ☐ Longer duration (weeks or months)
- ☐ Orbiting Earth
- ☐ Landing on the Moon
- ☐ Visiting another celestial body (e.g., Mars, Saturn, etc)

How much would you be willing to pay for a space tourism trip? (Please specify a range) \*

Your answer \_\_\_\_\_

How important is the safety record of ISRO in your decision to participate in space tourism \*

- ☐ Extremely important
- ☐ Very important
- ☐ Somewhat important
- ☐ Not very important
- ☐ Not important at all

Would you be willing to participate in training before going to space? \*

- ☐ Yes
- ☐ No
- ☐ Maybe

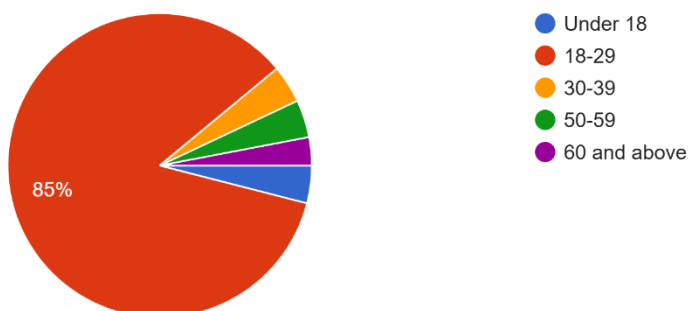


# CHAPTER 5: RESULTS AND DISCUSSION

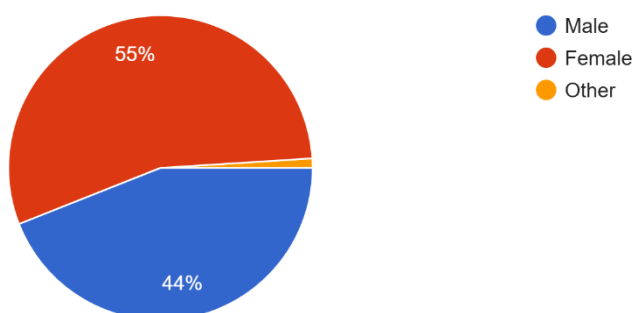
## 5.1 SURVEY REPORT

These are the responses received from the respondents..

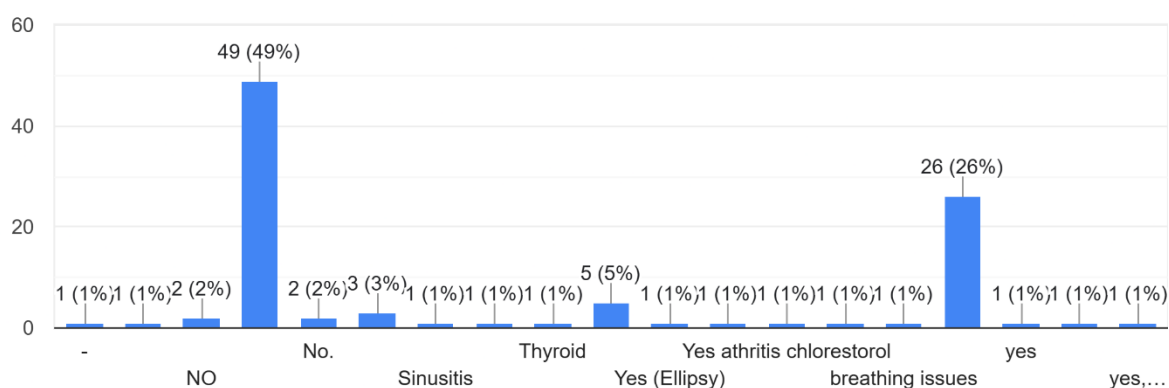
**Figure 1:** Age group responses are shown in the first pie chart, where **85%** of respondents are between the ages of 18 and 29.



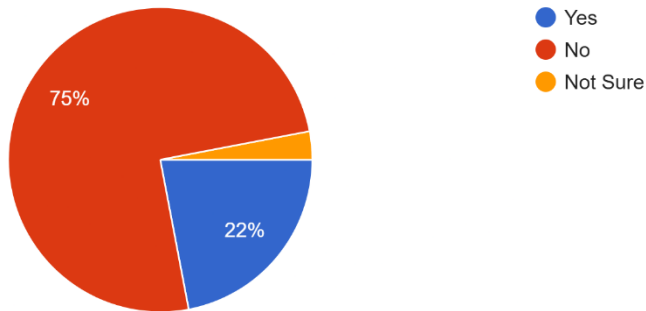
**Figure 2:** **55%** of respondents are female, **44%** are male, and a tiny percentage fall into another category, according to the second pie chart, which depicts the gender distribution.



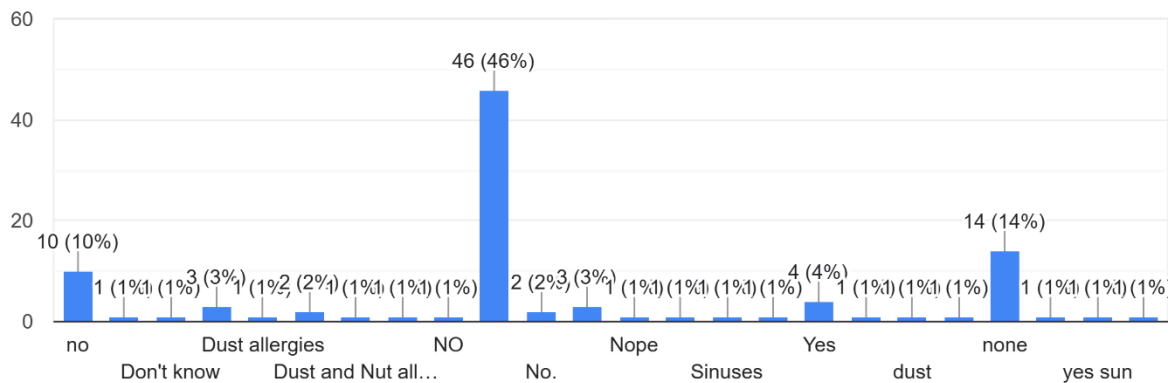
**Figure 3:** Of those surveyed, **49%** said they had no health issues. **26%** said they had a condition. Lower percentages of people mention other illnesses such sinusitis, thyroid problems, and breathing difficulties.



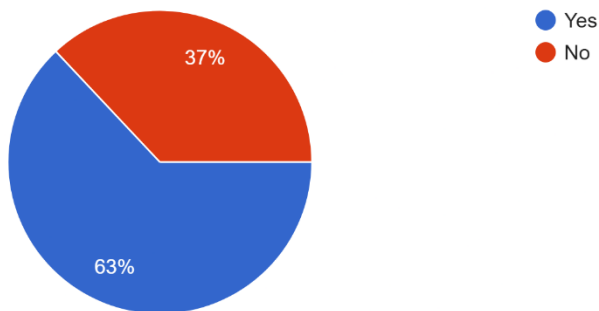
**Figure 4:** When asked whether they had undergone a cardiovascular or respiratory fitness test in the past year, **75% of respondents reported "No,"** while **22% said "Yes."** A small minority indicated they were "Not Sure."



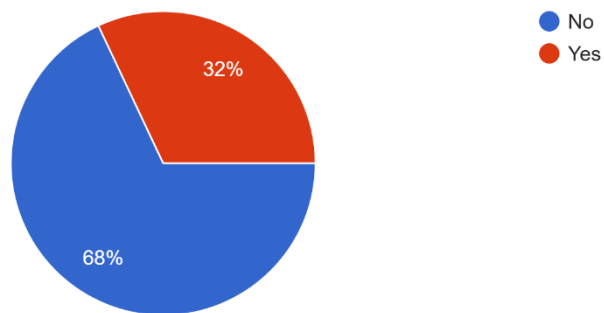
**Figure 5:** Of those surveyed, 46% said they had no allergies. Allergies were reported by 14%. 10% of those surveyed chose a different category.



**Figure 6:** In response to whether they were prepared to undergo medical training to manage the effects of microgravity—such as motion sickness and disorientation—**63% of participants answered "Yes,"** while **37% responded "No."**



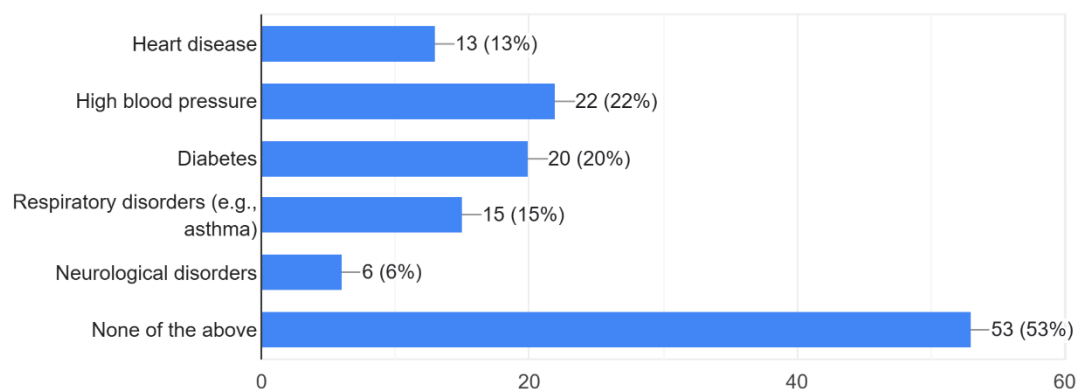
**Figure 7:** When asked about prior experience in extreme environments—such as deep-sea diving or high-altitude trekking—**68% of respondents said "No,"** while **32% reported having such experience.**



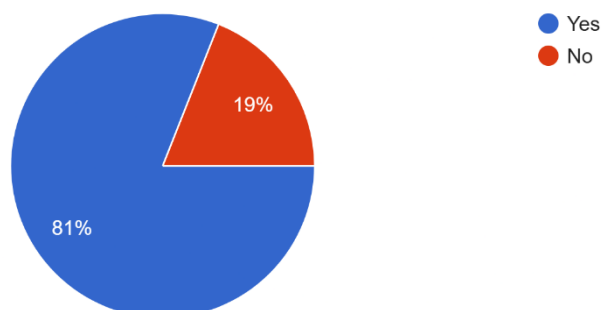
**Figure 8:**

When asked about their medical history, **53% of respondents indicated "None of the above."** The remaining responses included:

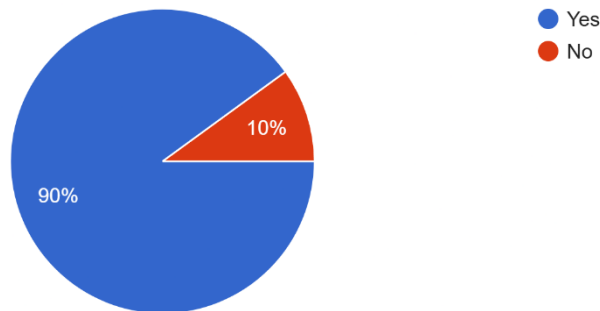
- **22% reporting high blood pressure**
- **20% reporting diabetes**
- **15% reporting respiratory disorders** (e.g., asthma)
- **13% reporting heart disease**
- **6% reporting neurological disorders**



**Figure 9:** When asked about their willingness to participate in follow-up health assessments after their space journey, **81% of respondents said "Yes,"** while **19% responded "No."**



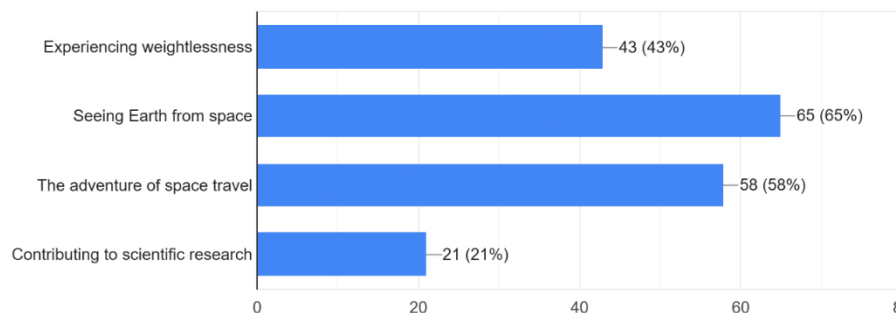
**Figure 10:** Regarding familiarity with ISRO (Indian Space Research Organisation), **90% of respondents indicated "Yes," while 10% responded "No."**



**Figure 11:**

When asked what excites them most about the idea of space tourism (select all that apply), respondents shared the following interests:

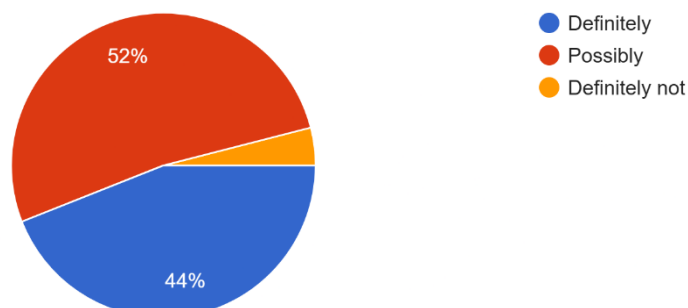
- **65%** selected **seeing Earth from space**
- **58%** chose **the adventure of space travel**
- **43%** were excited about **experiencing weightlessness**
- **21%** were interested in **contributing to scientific research**



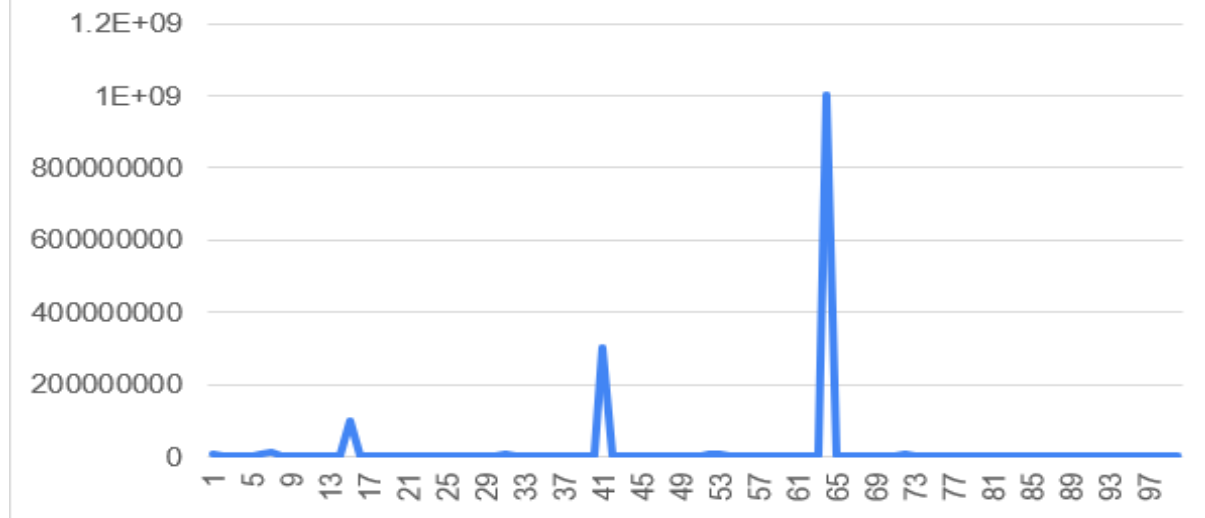
**Figure 12:**

When asked about their interest in participating in a space tourism trip organized by ISRO:

- **44%** responded **"Definitely"**
- **52%** said **"Possibly"**
- A **small percentage** (approximately **4%**) responded **"Definitely not"**



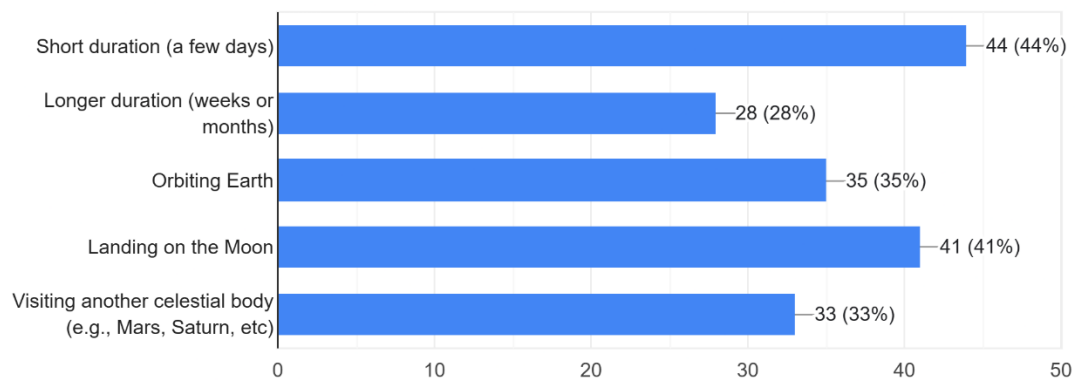
**Figure 13:** The distribution of what people are ready to pay is shown in a line graph, with values as high as ₹1,200,000,000.



**Figure 14:**

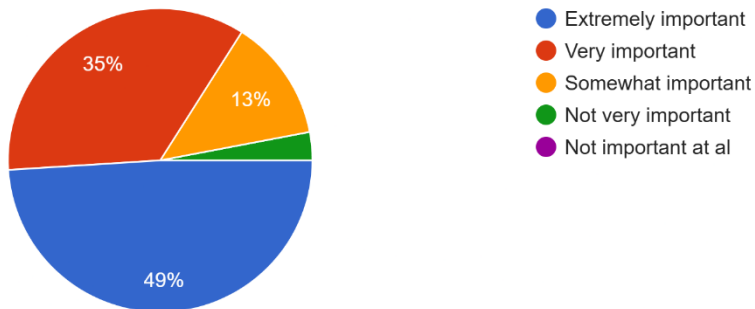
When asked about their ideal space tourism experience (select all that apply), respondents shared the following preferences:

- **44%** preferred a **short duration** (a few days)
- **28%** favored a **longer duration** (weeks or months)
- **41%** were interested in **landing on the Moon**
- **35%** wanted to experience **orbiting Earth**
- **33%** expressed interest in **visiting another celestial body** (e.g., Mars, Saturn)



When asked about the importance of ISRO's safety record in their decision to participate in space tourism:

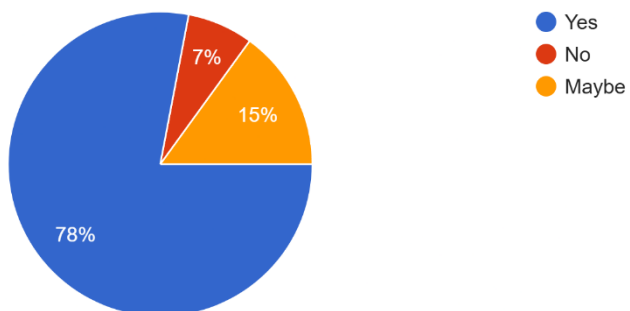
- **49%** considered it "Extremely important"
- **35%** rated it as "Very important"
- **13%** found it "Somewhat important"
- A minimal percentage selected "Not very important / Not important at all"



**Figure 16:**

When asked if they would be willing to participate in training before going to space:

- **78%** responded "Yes"
- **15%** said "Maybe"
- **7%** responded "No"



# CHAPTER 6: PERFORMANCE EVALUATION

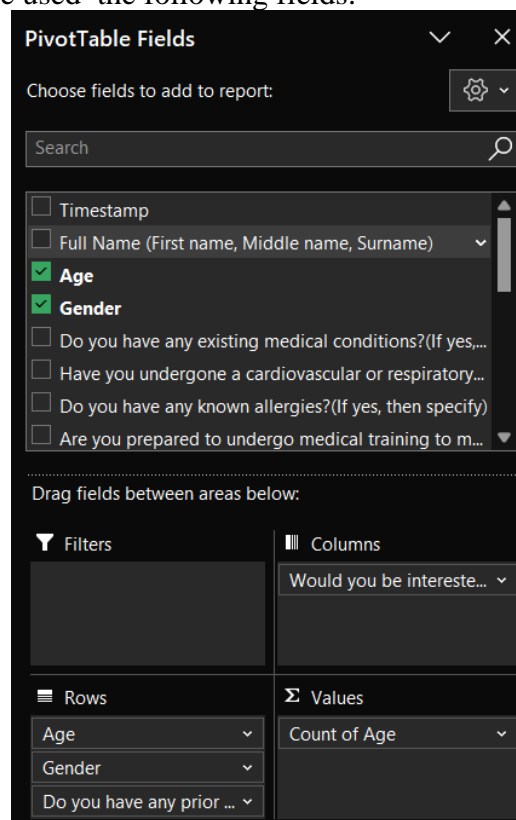
## RESULTS AND DISCUSSION

### 6.1 PARAMETRIC STUDY

For the analysis, we used the Chi-square test. It is one of the statistical techniques that is used to analyze categorical data is the chi-square test, which compares observed and anticipated values to determine whether or not there is a difference between the two sets. This method helps determine whether the provided data fits any known theoretical probability distribution, such as the Poisson or Normal distribution.

Symbolically written as  $\chi^2$ , this test assesses how well the observed data fits an expected model. It is most frequently used to examine the correlations between categorical variables in hypothesis testing. Raw, randomly chosen data from independent variables that are mutually exclusive and representative of the sample should be utilized for the Chi-Square test. To determine whether the observed values are statistically substantially different from the expected values, the Chi-Square statistic can be computed and the results compared to the critical value from the Chi-Square distribution table. This test provides information on whether the theoretical predictions match the actual outcomes by identifying patterns or relationships in categorical data.

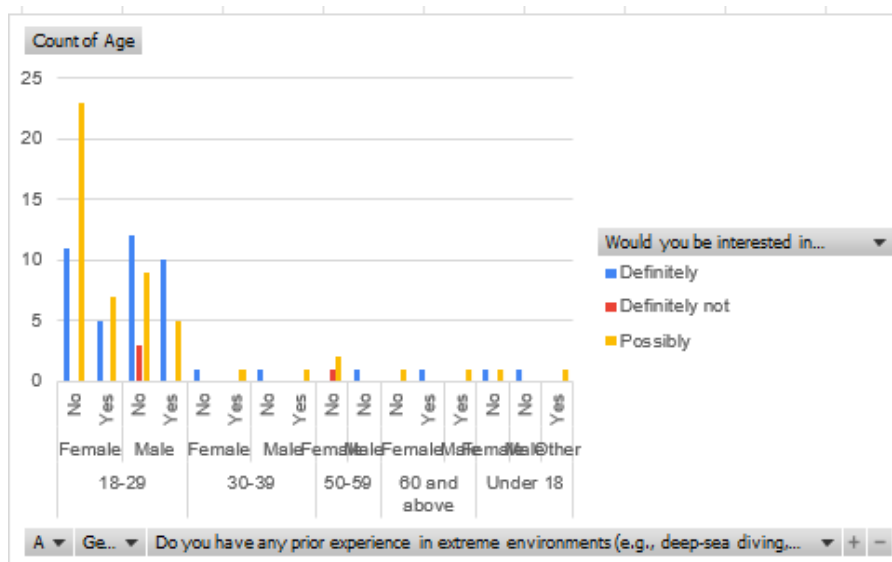
To create the pivot table we used the following fields:



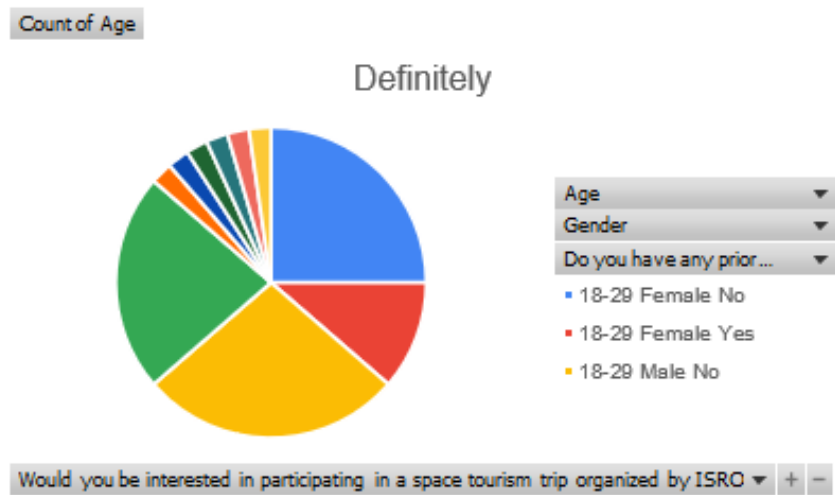
These are the values we observed in the responses.  
This is the pivot table:

Count of Age	Column Labels			
Row Labels	Definitely	Definitely not	Possibly	Grand Total
Female	19	1	35	55
18-29	16		30	46
No	11		23	34
Yes	5		7	12
30-39	1		1	2
No	1			1
Yes			1	1
50-59		1	2	3
No		1	2	3
60 and above	1		1	2
No			1	1
Yes	1			1
Under 18	1		1	2
No	1		1	2
Male	25	3	16	44
18-29	22	3	14	39
No	12	3	9	24
Yes	10		5	15
30-39	1		1	2
No	1			1
Yes			1	1
50-59	1			1
No	1			1
60 and above			1	1
Yes			1	1
Under 18	1			1
No	1			1
Other			1	1
Under 18			1	1
Yes			1	1
Grand Total	44	4	52	100

This is the bar and the pie chart:







When performing a Chi-Square test, it is essential to specify the Null Hypothesis ( $H_0$ ) and the Alternative Hypothesis ( $H_1$ ). Determining the threshold for rejecting the null hypothesis also requires establishing the statistical significance level. The null hypothesis is rejected if the p-value is less than or equal to 0.05, which indicates a significant link between the variables. Usually, a significance threshold of 0.05 (5%) is applied.

$H_0$ : Space Tourism will not be booming in the next decades.			
$H_1$ : Space Tourism will be booming in the next decades.			
p-values > 0.05 --> reject $H_0$			
p-values < 0.05 --> reject $H_1$			

After stating the null and alternative Hypothesis, we now create a table with the Observed values.

Observed Values				
Count of Age	Column Labels			
Row Labels	Definitely	Definitely r	Possibly	Grand Total
Female	19	1	35	55
18-29	16	0	30	46
No	11	0	23	34
Yes	5	0	7	12
30-39	1	0	1	2
No	1	0	0	1
Yes	0	0	1	1
50-59	0	1	2	3
No	0	1	2	3
60 and above	1	0	1	2
No	0	0	1	1
Yes	1	0	0	1
Under 18	1	0	1	2
No	1	0	1	2
Male	25	3	16	44
18-29	22	3	14	39
No	12	3	9	24
Yes	10	0	5	15
30-39	1	0	1	2
No	1	0	0	1
Yes	0	0	1	1
50-59	1	0	0	1
No	1	0	0	1
60 and above	0	0	1	1
Yes	0	0	1	1
Under 18	1	0	0	1
No	1	0	0	1
Other	0	0	1	1
Under 18	0	0	1	1
Yes	0	0	1	1
Grand Total	44	4	52	100

Now we calculate the Expected values by using the below formula:

$$\text{Expected} = (\text{row total} * \text{column total}) / \text{grand total}$$

These are the Expected values:

EXPECTED VALUES			
Row Labels	Definitely	Definitely r	Possibly
Female	24.2	2.2	28.6
18-29	20.24	0	23.92
No	14.96	0	17.68
Yes	5.28	0	6.24
30-39	0.88	0	1.04
No	0.44	0	0
Yes	0	0	0.52
50-59	0	0.12	1.56
No	0	0.12	1.56
60 and above	0.88	0	1.04
No	0	0	0.52
Yes	0.44	0	0
Under 18	0.88	0	1.04
No	0.88	0	1.04
Male	19.36	1.76	22.88
18-29	17.16	1.56	20.28
No	10.56	0.96	12.48
Yes	6.6	0	7.8
30-39	0.88	0	1.04
No	0.44	0	0
Yes	0	0	0.52
50-59	0.44	0	0
No	0.44	0	0
60 and above	0	0	0.52
Yes	0	0	0.52
Under 18	0.44	0	0
No	0.44	0	0
Other	0	0	0.52
Under 18	0	0	0.52
Yes	0	0	0.52

We then, use the chi-square formula:

$$(\text{observed values} - \text{expected value})^2 / \text{expected value}$$

(O-E) <sup>2</sup> /E			
Row Labels	Definitely	Definitely not	Possibly
Female	1.117355	0.654545455	1.45248227
18-29	0.888221	0	1.54541806
No	1.048235	0	1.60081448
Yes	0.014848	0	0.092564103
30-39	0.016364	0	0.001538462
No	0.44	0	0.001538462
Yes	0	0	0.443076923
50-59	0	6.453333333	0.124102564
No	0	6.453333333	0.124102564
60 and above	0.016364	0	0.001538462
No	0	0	0.443076923
Yes	0.712727	0	0
Under 18	0.016364	0	0.001538462
No	0.016364	0	0.001538462
Male	1.643058	0.873636364	2.068811189
18-29	1.365128	1.329230769	1.94469428
No	0.196364	4.335	0.970384615
Yes	1.751515	0	1.005128205
30-39	0.016364	0	0.001538462
No	0.712727	0	0
Yes	0	0	0.923076923
50-59	0.712727	0	0
No	0.712727	0	0
60 and above	0	0	0.443076923
Yes	0	0	0.443076923
Under 18	0.712727	0	0
No	0.712727	0	0
Other	0	0	0.443076923
Under 18	0	0	0.443076923
Yes	0	0	0.443076923

Before finding the p-value, we will first find the degree of freedom. The formula is:

$$df = (\text{Number of Rows} - 1) \times (\text{Number of Columns} - 1)$$

In Excel, the formula is:

$$= (\text{COUNTA}(A5:A34) - 1) * (\text{COUNTA}(B4:D4) - 1)$$

According to the formula, the degree of freedom was 58.

Now we will use the chi-square formula:

$$= \text{CHISQ.DIST.RT}(\text{Chi-Square Value}, \text{Degrees of Freedom})$$

## **6.2 SOLUTION AND RESULTS CONVERGENCE**

Using the formula we got 0.770107. According to chi-square, if p-values > 0.05 we have to reject H0 that stated “Space Tourism will not be booming in the coming decades.”

# CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

## Conclusion

Space tourism is on the rise, and ISRO has the potential to play a significant role with its cost-effective space missions. While challenges like cost, safety, and regulations remain, advancements in technology and growing interest suggest a promising future. With continued innovation and collaborations, space travel could become more accessible and shape a new era of exploration.

## Recommendations

The space tourism industry is demonstrating positive growth based upon existing trends and projections:

1. **Advances in Technology** – The reusable rocket technology of companies such as SpaceX, Blue Origin and Virgin Galactic is driving down costs and opening up space travel to more people.
2. **More Investments** — From private companies to national governments, space tourism is getting so much investment that it means constant ideas and developments.
3. **Tide as Space Travel Increases In Public Interest** – The rising number of individuals with wealth willing to pay for space seems to lead to greater growth.
4. **Regulatory Developments** – Governments are working to delineate guidelines for safe and commercially viable space travel.
5. **Missions** – From suborbital flights to orbiting hotels to lunar tourism, space tourism is growing quickly.

Considering these aspects, space tourism will grow in the coming decades. Though it was initially accessible only to the rich, advances in technology and economies of scale would likely eventually bring space travel within the financial reach of more people. While substantial challenges--safety concerns, environmental impact, and cost barriers, to the extent they still exist--remain, the continued innovation within the field may allow space tourism to become a viable and mainstream industry.

## **CHAPTER 8: REFERENCES**

- [1] Space Tourism: An Initiative Pushing Limits A. Yazıcı, S. Tiwari
- [2] Space Tourism —From Dream to Reality A. Buckley, W. Mendell
- [3] Space Tourism: The 21st Century “Frontier” V. Smith
- [4] History of Space Tourism C. Cater
- [5] TOURISM BEYOND ATMOSPHERE Mohammad Yaseen Malik, M. Khan
- [6] Space Tourism: Opportunities and Risks T. Roberts, M. Thompson
- [7] The Economics of Space Tourism R. Becker, A. Lee
- [8] Space Tourism and Human Spaceflight: A New Frontier for Exploration L. Andrews
- [9] The Future of Space Tourism and Its Legal Implications N. M. Gupta
- [10] Commercial Space Tourism: Opportunities and Challenges J. Davis, K. Peterson
- [11] Space Tourism: A New Era of Human Exploration J. F. Collins
- [12] Emerging Trends in Space Tourism and Their Societal Impact R. D. Wallace, P. Singh
- [13] Tourism Beyond Earth: Exploring the Frontiers of Space Travel D. R. Moore, J. Chen

# CHAPTER 9: PUBLISHED PAPER

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## The Future of Space Tourism: Assessing ISRO's Role with Current Technology

<sup>1</sup>Ashwini Panicker, <sup>2</sup>Apeksha Pandey, <sup>3</sup>Sneha Gokarnkar

<sup>1</sup>Student at Sheth L. U. Jhaveri. and Sir M.V. College of Arts, Science, and Commerce, <sup>2</sup>Student at Sheth L.U.J. and Sir M.V. College of Arts, Science, and Commerce, <sup>3</sup>Asst. Professor at Sheth L.U.J. and Sir M.V. College of Arts, Science, and Commerce

**Abstract:** Space tourism is becoming a serious industry as technology advances and more private companies enter the market. ISRO has made significant advances in space exploration with low-cost rockets like as PSLV and GSLV. This study investigates how ISRO may affect the future of space tourism by examining its technological capabilities, challenges, and opportunities. Using a survey and chi-square analysis, the study assesses public interest in space travel and whether commercial space tourism is feasible in India. According to the findings, space tourism will expand in the coming decades as technology advances and costs fall. However, there are major difficulties to address, such as making it affordable, safe, and sustainable. The paper concludes by stating that if ISRO invests in reusable launch technologies and collaborates with other countries, India might become a major global space tourism market player.

**IndexTerms** - Space Tourism, ISRO, Gaganyaan, PSLV, GSLV, RLV, Space Exploration, LEO, Chi-Square Analysis.

### 1. INTRODUCTION

However, ISRO has goals beyond Gaganyaan. To create reusable launch vehicles and advanced space infrastructure, the agency is collaborating closely with private businesses. India is well-positioned to compete in the global space tourism sector because to affordable launch systems like the Geosynchronous Satellite Launch Vehicle (GSLV) and the Polar Satellite Launch Vehicle (PSLV). These developments strengthen India's standing as a pioneer in reasonably priced space technology while also facilitating access to space flight.

The dream of common people visiting space could soon come true as ISRO keeps coming up with new ideas and working with commercial companies. India is positioned to play a significant role in the future of space travel with its emphasis on cost, efficiency, and technological strength.

The Gaganyaan mission, which aims to put Indian astronauts into low Earth orbit (LEO), is a major milestone in India's space exploration history. Beyond demonstrating ISRO's capability in human spaceflight, the landmark mission marks India's entry into a select club of nations that have carried out crewed space missions. Gaganyaan is paving the way for future space exploration — and maybe space tourism — with spacecraft re-entry tech and astronaut training.

But ISRO is not just focused on Gaganyaan. The agency is partnering closely with private enterprise to develop reusable launch systems and sophisticated space infrastructure. Affordable launch systems such as the Geosynchronous Satellite Launch Vehicle (GSLV) and the Polar Satellite Launch Vehicle (PSLV) have positioned India to compete globally in the space tourism sector. These developments bolster India's position not only as a leader in affordable space technology but also increasing access to space flight.

ISRO keeps innovating and collaborating with commercial companies, and it may not be long before the dream of regular people visiting space becomes a reality. With its launch cost exceptions, efficient power and robust science, India is set to play a major role in the future of way space travel.

### 1.1 Literature Review

Gupta and his team (2007) noted that ISRO had been able to make necessary technological advancements for the launch of its next two space vehicles. The study argued that ISRO had obtained the necessary capabilities for the Polar Satellite Launch Vehicle (PSLV) and the Geosynchronous Satellite Launch Vehicle (GSLV). Furthermore, the research report stated that the institution presented proficiency in the launch of a group of satellites, which again demonstrated India's increasing ability in the area of space technology and exploration.

Pandey (2013) has put forth the view that besides being the aircraft development powerhouse, India has shown great promise in developing low-cost flying vehicles for commercial use. This particular study focussed on the improvements the country is witnessing in the aerospace area, particularly the capacity of the country to produce cost-effective flying vehicles. Notwithstanding these achievements, the research also pointed out that India was not in a position to engage itself in space tourism at that time. So the conclusions seem to

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propose that even though the country is doing well in the field of aviation innovation, it has to go for the next level by embracing opportunities beyond space.

According to Sivan and Pandian (2018), the Indian Space Research Organization (ISRO) was working efficiently on the Reusable Launch Vehicle (RLV) technologies. The report pointed out one of the key stages of this work, namely that in 2016, ISRO had even carried out a technology demonstrator flight, which turned out to be a big success. This step made it possible to save a lot of money and fly more efficiently insofar as the equipment could be reused, which in turn would significantly lower the cost, and thereby caused an increase in the sustainability of space missions.

In 2010, Sundararajan stated that the Indian Space Research Organization (ISRO) had made outstanding performance with the success of both the Polar Satellite Launch Vehicle (PSLV) and the Geosynchronous Satellite Launch Vehicle (GSLV) systems. He also mentions ISRO's plans for the future, one of which includes the development of heavy-lift launchers to make possible further space missions. Moreover, the study seems to be very confident that the Organization's project of launching a human spacecraft will happen very soon, which will definitely be a greater and landmark step toward the country's space program. India will then join the most advanced countries in the sphere of space exploration.

Sundararajan (2020) has presented the news that Indian Space Research Organization (ISRO) declared to the public the Gaganyaan Mission, whose objective is to send humans into space. The article drew attention to ISRO's aspirations regarding human space flight to Low Earth Orbit (LEO) by 2022, which are fundamental for India's successful space exploration strategy. This mission was exceptional work in securing India as a significant actor in crewed space missions, and also in catching the country's growing talent in sophisticated space technologies.

## 1.2 Objectives of the Study

- The biggest developments in space tourism; ISRO's efforts and scope in the future.
- To analyze the potential rise of space tourism in the next few decades and what impact it would have on society and the economy.
- Analyse the space tourism industry, challenges and opportunities, and recommendations for sustainable development.

**Hypothesis H0:** Space tourism will not be booming in the coming decades.

**Hypothesis H1:** Space tourism will be booming in the coming decades.

## 1.3 Scope

The present study explores the concept of space tourism as a future thing, particularly with its emphasis on ISRO's activities and progress. The main areas of concern are the technological, economic, and social changes, bringing with them the advantages and challenges of sustainable growth. This study is based on the existing developments and the future of the industry, indicating India's contributions to it.

## ILRESEARCH METHODOLOGY

### 2.1 Data Collection

This study uses primary data acquired through a questionnaire taken by people from across the world. The data is examined using the chi-square test.

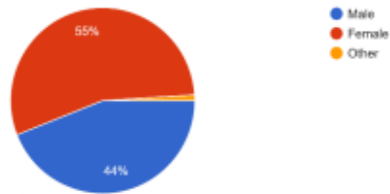
### 2.2 Data Analysis and Interpretation

AGE GROUP	NO. OF PEOPLE	PERCENTAGE
Under 18	4	4%
18-29	85	85%
30-49	4	4%
50-59	4	4%
60 and above	3	3%

**Table 1. Age group of Respondents.**

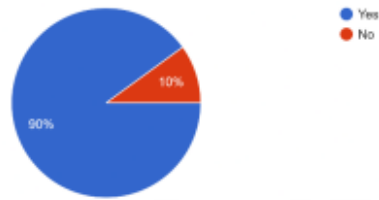
Out of 100 responses, above are the divisions according to the age groups of respondents, where the maximum number of respondents were in the age group of 18-29 years and the lowest number of them were the ones 60 and older.





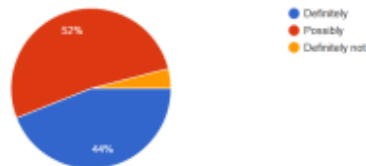
**Figure 1. Gender classification of the respondents.**

The graphic is a pie chart that depicts gender distribution. It displays 55% female (red), 44% male (blue), and a minor number of other (orange). A legend on the right shows the colors for each category.



**Figure 2. Familiar with ISRO**

90% of the people are familiar with ISRO while 10% aren't familiar.



**Figure 3. People's interest in going to space.**

The image depicts a pie chart of response distribution. 44% (blue) is "Definitely," 52% (red) is "Possibly," and a small amount (orange) is "Definitely Not." The corresponding colors are indicated by a legend to the right.

### III. RESULTS AND DISCUSSION

#### 3.1 Chi-square test

Based on a predetermined premise, the Chi-Square test is used to assess the relationship between space tourism and contemporary technical developments, looking at how they affect people in various businesses.

##### Formula:

$$\text{Chi-square } (\chi^2) \text{ Test in } r \times c \text{ Contingency Table} = \sum_i \sum_j \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

Where: O = Observed values, E = Expected values

**Table 2. Observed Values**

	Interested in participating in a space tourism trip organized by ISRO			Total
	Definitely	Definitely Not	Possibly	
Female	19	1	35	55
18-29	16	0	30	46
No	11	0	23	34
Yes	5	0	7	12
30-39	1	0	1	2
No	1	0	0	1
Yes	0	0	1	1
50-59	0	1	2	3
No	0	1	2	3



60 and above	1	0	1	2
No	0	0	1	1
Yes	1	0	0	1
Under 18	1	0	1	2
No	1	0	1	2
Male	25	3	16	44
18-29	22	3	14	39
No	12	3	9	24
Yes	10	0	5	15
30-39	1	0	1	2
No	1	0	0	1
Yes	0	0	1	1
50-59	1	0	0	1
No	1	0	0	1
60 and above	0	0	1	1
Yes	0	0	1	1
Under 18	1	0	0	1
No	1	0	0	1
Other	0	0	1	1
Under 18	0	0	1	1
Yes	0	0	1	1
Grand Total	44	4	52	100

Expected value = (Row Total \* Column Total) / Grand Total

Table 3. Expected Values

	Interested in participating in a space tourism trip organized by ISRO		
	Definitely	Definitely Not	Possibly
Female	24.2	2.2	28.6
18-29	20.24	0	23.92
No	14.96	0	17.68
Yes	5.28	0	6.24
30-39	0.88	0	1.04
No	0.44	0	0
Yes	0	0	0.52
50-59	0	0.12	1.56
No	0	0.12	1.56
60 and above	0.88	0	1.04
No	0	0	0.52
Yes	0.44	0	0
Under 18	0.88	0	1.04
No	0.88	0	1.04
Male	19.36	1.76	22.88
18-29	17.16	1.56	20.28
No	10.56	0.96	12.48
Yes	6.6	0	7.8
30-39	0.88	0	1.04
No	0.44	0	0
Yes	0	0	0.52
50-59	0.44	0	0
No	0.44	0	0
60 and above	0	0	0.52
Yes	0	0	0.52
Under 18	0.44	0	0

No	0.44	0	0
Other	0	0	0.52
Under 18	0	0	0.52
Yes	0	0	0.52

Table 4. Calculating  $((O_{ij} - E_{ij})^2 / E_{ij})$ 

	Interested in participating in a space tourism trip organized by ISRO		
	Definitely	Definitely not	Possibly
Female	1.117355	0.654545455	1.45248227
18-29	0.888221	0	1.54541806
No	1.048235	0	1.60081448
Yes	0.014848	0	0.092564103
30-39	0.88	0	1.04
No	0.44	0	0.001538462
Yes	0	0	0.443076923
50-59	0	6.453333333	0.124102564
No	0	6.453333333	0.124102564
60 and above	0.016364	0	0.001538462
No	0	0	0.443076923
Yes	0.712727	0	0
Under 18	0.016364	0	0.001538462
No	0.016364	0	0.001538462
Male	1.643058	0.873636364	2.068811189
18-29	1.365128	1.329230769	1.94469428
No	0.196364	4.335	0.970384615
Yes	1.751515	0	1.005128205
30-39	0.016364	0	0.001538462
No	0.712727	0	0
Yes	0	0	0.923076923
50-59	0.712727	0	0
No	0.712727	0	0
60 and above	0	0	0.443076923
Yes	0	0	0.443076923
Under 18	0.712727	0	0
No	0.712727	0	0
Other	0	0	0.443076923
Under 18	0	0	0.443076923

To calculate  $\chi^2$ , add the values of  $((O_{ij} - E_{ij})^2 / E_{ij})$  to get 49.78642297.

To test the hypothesis at the 0.05 level of significance, deduct the p-value generated by the formula:

**p-value = CHISQ.DIST.RT( $\chi^2$ , Degree of Freedom)**

Where Degree of Freedom = (Total number of Rows - 1) \* (Total number of Columns - 1)

**Degree of Freedom = 58**

Therefore,

p-value = CHISQ.DIST.RT(49.78642297, 58)

**p-value = 0.770107**

#### IV. FINDINGS

The calculated p-value is greater than the acceptance level of significance at 0.05 makes it evident that Space Tourism will be booming in the next decades, H1 is accepted and H0 is rejected.

#### V. CONCLUSION

After exploring this analysis, space tourism is anticipated to boom post the current period, carried by the victory of technology, the growing role of the private sector, and additional programs like ISRO's upcoming space programs. As the cost of space travel goes down, and its availability logic becomes more optimistic, the space tourism industry will move from being an elite indulgence to a more mainstream one.

Nevertheless, problems such as high costs, safety issues, and the eco-effect must be worked out for the growth to be sustainable. The establishment of international partnerships, the creation of a regulatory framework, and further research are the significant steps that need to be taken in order to make the space tourism industry a real and long-term sector. By gaining more focus on the use of reusable launch vehicles and financially viable space missions, ISRO is expected to launch India into the leadership of aerospace tourism.

## VI. SUGGESTIONS

### 1. Cost Reduction Strategies

- Put money into reusable launch vehicles (RLVs) to cut down space travel costs.
- Create budget-friendly suborbital flights for quick space trips.
- Push for teamwork between public and private sectors to fund and make space tourism a business.

### 2. Making Safety Better

- Put in place cutting-edge life-support systems and plans for emergencies.
- Set up thorough training before flights for space tourists.
- Boost protection from radiation and make spacecraft tougher for long trips.

### 3. Space Travel That Lasts

- Study and build green propulsion systems to lessen harm to the environment.
- Start programs to balance out carbon to offset emissions from rocket launches.

### 4. Growing Infrastructure

- Build hotels in space and research stations in orbit for long stays.
- Create spaceports and training centers to keep up with rising demand.

### 5. Stronger Regulations and Policies

- Create international space laws to guide liability, safety, and travel.
- Make sure space tourism takes into account ethical issues like using resources and caring for the environment.

### 6. Public Awareness and Training

- Boost educational programs to spark interest in space tourism.
- Start simulated space experiences to get potential tourists ready.

These steps will help ISRO and global space agencies speed up the creation of space tourism that's safe, cheap, and long-lasting for people in the future.

## REFERENCES

- [1] Pandey, M. (2013) . Space Tourism's Potential in India: Challenges and Fears. <https://doi.org/10.9790/487X-1143239> IOSR-JBM, 11(4), 32-39
- [2] V. Sundararajan (2010). Indian Space Transportation Systems: An Economic and Performance Analysis. The article 10.2514/6.2010-8708
- [3] (2020) V. Sundararajan. Design of Socio-Technical Systems (STS) and Strategic Views of India's Human Spaceflight Program: The Gaganyaan Mission. Forum for AIAA Scitech 2021. The article <https://doi.org/10.2514/6.2021-0306>
- [4] S. Pandian and K. Sivan (2018). A Synopsis of the Reusable Launch Vehicle Technology Exhibit.Cs/v114/01/38-47 10.18520
- [5] B. N. Suresh, K. Sivan, and S. Gupta (2007). Indian launch vehicle technology development. 24102 <https://www.jstor.org/stable>